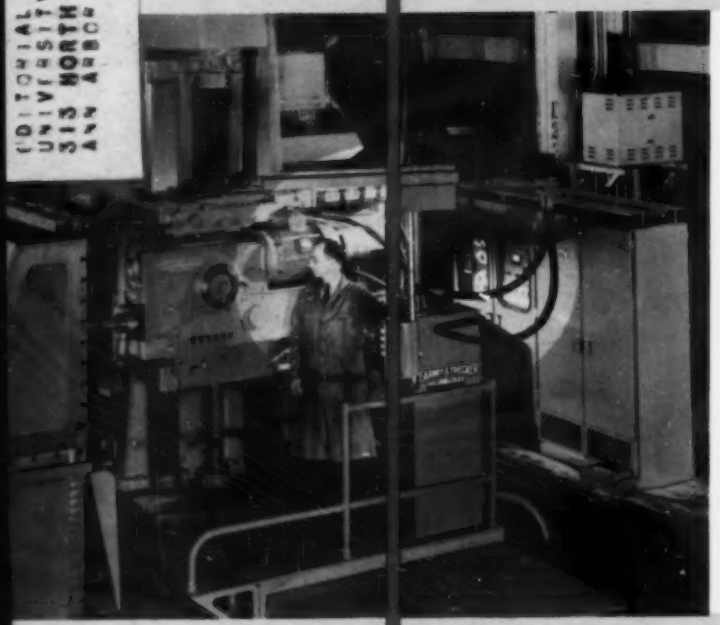
Hydraulics & Pneumatics

JUNE 1960

EDITORIAL DEPT
UNIVERSITY MICROFILMS
313 NORTH FIRST ST INC
ANN ARBOR MICH A1-82214



HYDRAULIC SERVO PERFORMANCE IN NUMERICALLY CONTROLLED MACHINE TOOLS

see contents page 3

THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

Also in this issue:
- *Electrohydraulic Servovalves in Industry*
- *Pneumatic Escapement Feeds Bowling Pins*
- *Applying Electrical Controls — Part 1*

Thoroughly Proved...

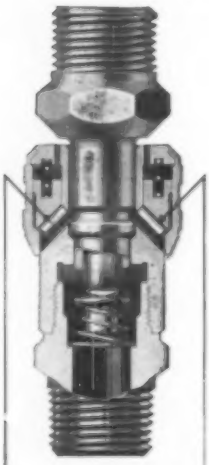
BY YEARS OF HARD EVERYDAY USE IN THOUSANDS OF PLANTS

HANSEN

QUICK-CONNECTIVE

PUSH-TITE COUPLINGS

Wherever you have fluid line connections...



Tamper-Proof Socket Head—with leak-proof, minimum wear, locking device.

—AS EASY AS PLUGGING IN YOUR ELECTRIC SHAVER

- Quick connection and disconnection—as easy as plugging in your electric shaver.
- Instant automatic flow or shut-off.
- Factory assembled socket head cannot be readily damaged—or have component parts lost by casual tampering.
- Locking pins afford large area contact with Plug—reduces wear to a minimum.

Write for the Hansen Catalog

Here is an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings.

Representatives in Principal Cities...See Yellow Pages

SINCE 1915

QUICK-CONNECTIVE FLUID LINE COUPLINGS

THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 35, OHIO

...unusual features solve your cylinder problems

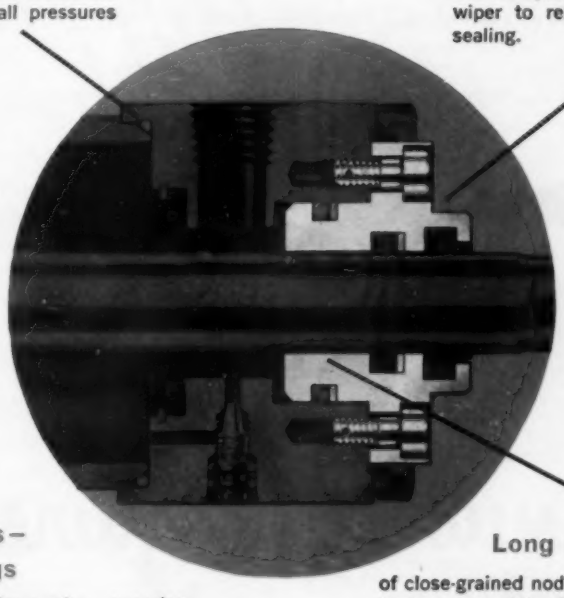
NEW HANNA *Powrmation* SERIES 1000 CYLINDERS

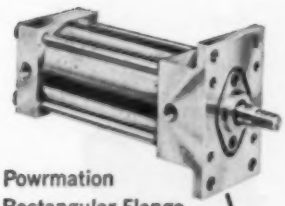
Pressure Safe Tube Seals

on the outside diameter of the tube create the most positive seal possible at all pressures from zero to maximum.

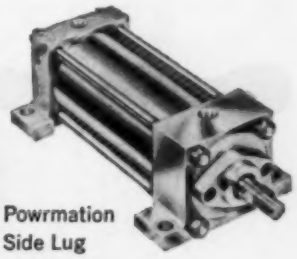
Fast Change Cartridge Gland

has leak-proof, low-friction rod seal and a rod wiper to remove dirt and to provide extra sealing.





Powrmation Rectangular Flange Rod End



Powrmation Side Lug Mounting

One Piece Steel Heads– Welded Steel Mountings

for maximum strength, perfect alignment . . . superior to bolted assembly. Mountings carry maximum cylinder load with ample safety margin.

Long Lubricated Bearing

of close-grained nodular iron with high graphitic content . . . one of the finest bearing materials. Rod seal on external side of bearing provides automatic bearing lubrication by hydraulic fluid or airborne lubricant.

POWRMATION CYLINDERS FOR AIR TO 250 PSI • HYDRAULIC TO 1000 PSI • BORES: 1½" THROUGH 14"

All good cylinders have "features" but few have a combination of really *Unusual* features that assure superior cylinder performance and dependability . . . New Hanna Powrmation Cylinders have. The features shown above and several others like: Unique, Check-Valve Cushions; Low Friction Nodular Iron Pistons; Positive Seal Block Vee Packings; Chrome Plated High Strength Steel Rod;—all these together with Hanna precision manufacturing and Hanna Field Engineering Service are the reasons why it will pay you to specify Powrmation Cylinders . . . they meet J.I.C. recommendations and have dimensional interchangeability.

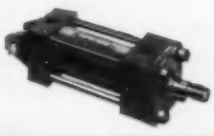
For Top Performance in Hydraulic Pressures

2000 PSI/3000 PSI Non Shock

HANNA POWRDRAULIC

Series 2000 CYLINDERS

Bores 1½" thru 8"



Write for Catalog 1000

or ask Your Hanna Representative— see the Yellow Pages or Sweet's Design Catalog for his name

HANNA ENGINEERING WORKS

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES

1741 Elston Avenue • Chicago 22, Illinois

MINNESOTA MR RUBBER

FACTS for FILING on SILICONE

For Unusual Requirements SILICONE is the answer!

Silicone rubber has been found by many designers to be the material needed for their "special" application. Whether you are designing space vehicles, high-performance aircraft components, radar or electronic components, parts for nuclear applications, or seals for use in an automatic transmission or steam iron you too will probably be able to improve your product through the use of silicone. In many of these applications, silicone with its unusual properties is a must.

To make silicone even more useful to designers, Minnesota Rubber fabricates parts by injection molding. This exclusive method of molding produces parts which are completely uniform in all respects. You know exactly what you are getting when you specify silicone parts or extrusions from Minnesota Rubber.

TYPICAL PROPERTIES OF MINNESOTA RUBBER SILICONE COMPOUNDS:

Temperature range	−130 to 500° F
Tensile strength, psi	600 to 900
Tear strength, lb/in	40 to 75
Elongation, %	150 to 300
Compression set, % @ 300° F	15 to 40
Hardness range, durometer	20 to 90
Dielectric strength, volts/mil	400 to 500

Oil resistance, depending on oil—good to excellent

FOR MORE INFORMATION ON SILICONE

WRITE: MINNESOTA MR RUBBER

NFPA

FREE COVER TO BIND YOUR MR "FACTS FOR FILING" PAGES

DEPARTMENT 110 • 3630 WOODDALE AVENUE
MINNEAPOLIS 16, MINNESOTA

Hydraulics & Pneumatics

VOLUME 13 / NUMBER 6

JUNE 1960

THE MAGAZINE OF FLUID POWER

ALLAN E. MORRIS
editor

BERT BENKENDORF
associate editor

JACK LOWERY
associate editor

EDWIN JACOBS
assistant editor

JAY MYERS
editorial assistant

HENRY LEFER
eastern editor, New York

SCHOLER BANGS
western editor, Los Angeles

JOHN A. LANKESTER, A.R.Ae.S.
European editor

ALARIC MAUSSER
art director

DEPARTMENTS

8 . . . Fluid Power Lines

12 . . . Letters to the Editor

16 . . . Fluid Power Forum

24 . . . Briefs

46 . . . Future Events

52 . . . New Products

62 . . . Useful Literature

112 . . . Aviation News

116 . . . Aircraft Component Data

122 . . . Fluid Power Patents

140 . . . Post Scripts of Industry

145 . . . Market Place

146 . . . Advertisers' Index

148 . . . Index to Advertised Products

FLUID POWER FOR MACHINE TOOLS

Hydraulic Servo Performance in Numerically Controlled Machine Tools 67
By F. J. Cizek

Electrohydraulic Servovalves in Industry—Part 1 Types of Servovalves 72
By Harvard B. Kolm

Deceleration Without Cams 75
By Vincent C. Webster and Peter Coffaro

How Slip Compensation Keeps Band Speed Constant 76
By Charles Whitmore

Deep Drill Index Adjusts Advance Stroke and Depth 80
By J. R. Fawcett

How Two Machine Tool Builders Control Speed 84
1. By Michael Zajak
2. By William B. Retz and Jacques Carpenter

Proximity Detector Checks Drill Breakage 92
By Michael Zajak

Cylinder Design Sequences Turret Drill 94
By J. L. Berg

PRODUCT APPLICATION

Pneumatic Escapement Feeds Bowling Pins 88
By Andrew M. Damer

Fast Acting Air, High Force Oil Combine on Press 90
By Elmer F. Heiser

Applying Electrical Controls—Part 1 Why Solenoids Burn Out 96
By D. Fitzpatrick

AIRCRAFT SECTION

How Temperature Affects Hydraulic Servo Performance 102
By August S. Lermer

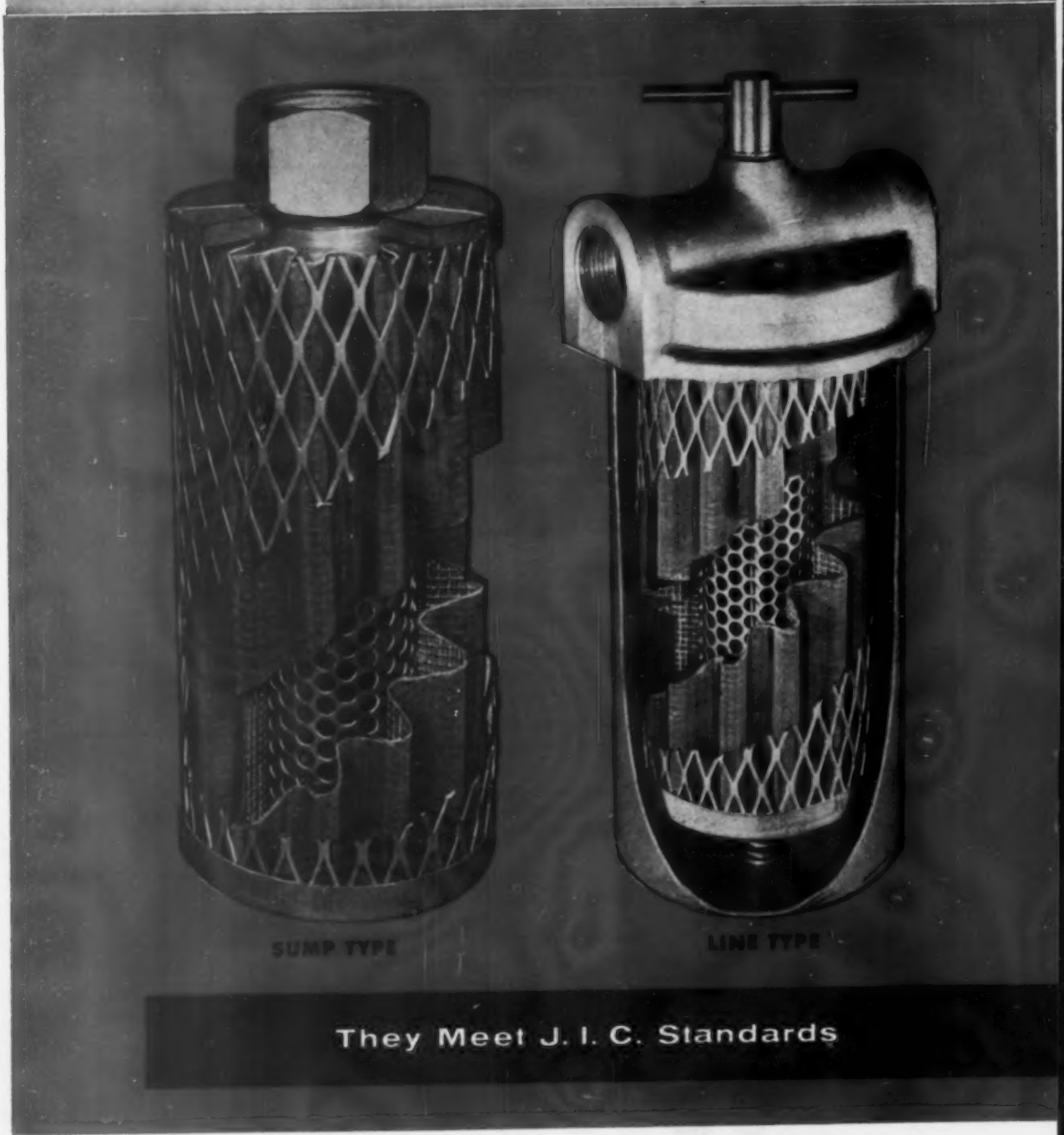
Pressure Sensing Actuator Speeds Wiper Reversal 108
By Jack H. Eichler

copyright 1960 by The Industrial Publishing Corporation

IBPA

FILTER Quality cannot be

SINCE 1943



They Meet J. I. C. Standards

compromised by FILTER Price!

THE ANSWER TO FILTER Quality IS

MARVEL

SYNCLINAL FILTERS

Over 900 O.E.M.'s can't be wrong!

16 years ago, Marvel Engineering Co. produced the first filter designed to maintain the cleanliness of oils, imperative in hydraulics and other low pressure circulating systems. Acceptance of Marvel Synclinal Filters to meet these rigid requirements sparked the surge to our leadership in this field, the status we presently maintain. This fact is attested by well over 900 Original Equipment Manufacturers, who are installing Marvel Synclinal Filters as standard equipment.

For further information—
write, wire or phone:

Check these EXCLUSIVE Marvel Features:

- **BALANCED SYNCLINAL DESIGN.** The all-important balance between *ACTIVE* filtering area and storage capacity for filtered out particles in Marvel Synclinal Filters provide longer periods of efficient filtration and dependable protection on hydraulic and other low-pressure circulating systems.
- **CONSTRUCTION.** Marvel Filters are of sturdy construction with all parts interchangeable. Should any part become damaged by accident or mishandling, you need only to replace the damaged part rather than purchasing a complete new filter. Your first cost may very well be your only cost.
- **VERSATILITY.** Marvel Synclinal Filters are available for Sump or Line installations. Eight individual capacity sizes from 5 to 100 G.P.M. You can get a filter for the particular fluid you are using—regular petroleum base hydraulic oils, all types of Fire-resistant hydraulic fluids, coolants, lubricants or water.
- **DEGREE OF FILTRATION.** Filtering media in Marvel Synclinal Filters is Monel Wire Cloth available in mesh sizes of 30-40-50-60-80-100-150 and 200 to meet your degree of filtration requirements. Before fabricated into Marvel Synclinal Filters, all wire cloth is subjected to rigid inspection at our plant. No factory rejected cloth or remnants are ever used.
- **EASY TO CLEAN.** Marvel Filters are easily disassembled, thoroughly cleaned and re-assembled in a matter of minutes—resulting in the equivalent of a brand new filter, ready for another long period of efficient service.
- **IMMEDIATE DELIVERY.** Marvel not only delivers a top grade filter in both quality and performance, but delivers IMMEDIATELY—a phone call can get your shipment on its way TODAY!

MARVEL ENGINEERING COMPANY

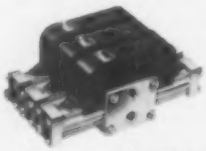
7227 NORTH HAMLIN AVENUE, CHICAGO 45, ILL. • PHONE: JUniper 8-6023

New! ...from Waterman

MAJOR BREAKTHROUGH IN HYDRAULIC VALVE DESIGN!

Series 1617-A A.C. 4-Way Solenoid Valves

- No inrush current
- Very fast cycling permissible
- No dynamic seals—packless
- High capacity—low pressure drop
- Compact—light in weight
- For pressures to 3000 p.s.i.
- Rock-bottom cost
- No coil burn-out if valve sticks



Designed for simplified stacking or banking

Here it is—the new pace-setter in A.C. solenoid valves! Exclusive Waterman design has eliminated inrush current, making possible fast cycling (in excess of 250 per minute) without overheating. Standard coils suitable for 25 to 60-cycle current. Weight of ⅜" size is less than 6 lbs., including two solenoids. Closed-center, tandem, and two-position types available. Rated 3000 p.s.i. pressure may be applied to all ports. Working parts totally immersed in hydraulic fluid. No moving seals—packless. Screw-type electrical terminals in steel housing. Also furnished for D.C. operation.

SEND TODAY FOR YOUR COPY OF NEW CATALOG 2902

Also suppliers of AN and MS qualified flow regulators and fuses, including flow regulators for fuels and cryogenic fluids

WATERMAN HYDRAULICS CORPORATION

WATERMAN HYDRAULICS CORPORATION • 725 Custer Avenue, Evanston, Illinois

Circle **137** on Time-Saver Card

Hydraulics & Pneumatics

THE MAGAZINE OF FLUID POWER

BUSINESS STAFF

ROBERT D. SHATTUCK *business manager*
BERT BENKENDORF *production manager*
N. G. KISER *..circulation director*
ROSE BLACK *.....reader service*

FRANCHISE DEPARTMENT

ALAN J. KICHLER *general manager*
F. MASON *.....representative*
MICHAEL NASSIF *.....production*

SALES OFFICES

Cleveland 15
812 Huron Rd., SU 1-9620
ROBERT G. JOSEPH

New York City 17
Rm. 835, 60 E. 42 St., MU 7-3420
LEE HAAS *vice-president*
DAN J. ROWLAND

Chicago 11
Rm. 704, 520 N. Michigan, WH 3-1655
CHARLES F. GEYER *vice-president*
SAM TRACY

Los Angeles 57
Granada Building
672 S. Lafayette Park Pl., DU 7-5104
ALAN T. CAZIER, *manager*
PAUL MANNING

London, S. W. 1
31 Palace St., Westminster, VIC 2608
JOHN A. LANKESTER, *manager*

SUBSCRIPTIONS in U.S. and possessions: $7.00, 1 year; $12.00, 2 years. Canada: $8.00 per year. Foreign: $10.00 per year, payable in advance in U. S. funds. U.K.: £3.5.0 per year payable in Sterling to London office. Single copy price: 75 cents.

Out-of-print copies of HYDRAULICS & PNEUMATICS Magazine are available from: University Microfilms, 313 N. First Street, Ann Arbor, Michigan.

published monthly by

The INDUSTRIAL PUBLISHING CORPORATION
812 Huron Rd., Cleveland 15, Ohio

IRVING B. HEXTER *.....president*
LESTER P. AUERBACH *executive v.p.*
EDWIN M. JOSEPH *.....first v.p.*
PAUL ROLNICK *....vice president*
N. N. GOODMAN *....vice president*
LEE HAAS *.....vice president*
CHARLES F. GEYER *..vice president*
E. J. HEXTER *.....vice president*
ALAN J. KICHLER *..asst. sec.-treas.*

AFFILIATED PUBLICATIONS:

Material Handling Engineering (formerly Flow), Material Handling Illustrated, Modern Office Procedures, Occupational Hazards, Power Transmission Design, Precision Metal Molding, The Refrigeration & Air-Conditioning Business, Welding Design & Fabrication. Member BPA.

Published monthly. Accepted as controlled circulation publication at Pontiac, Illinois. Please return 3579 forms to 812 Huron Road, Cleveland 15, Ohio. Printed in U.S.A.

USEFUL LITERATURE

WIDE SELECTION of REUSABLE HYDRAULIC COUPLINGS

. . . for fast, economical emergency and field repairs on such equipment as agricultural, earth moving, machine tool, frame straightening, material handling, automotive, fire fighting, oil field, and many more . . . is featured in the new Anchor Catalog No. 303.

Anchor Coupling Company has the most complete line of hose couplings and fittings for industrial usage and provides the greatest variety of thread combinations.

The New Anchor Catalog No. 303 contains a wealth of technical and engineering data invaluable to both engineer and user, including: thread information; how to measure length of hose assemblies; nomographic chart; assembly instructions; etc., in addition to complete product and application recommendations for Anchor's many styles of Reusable Hydraulic Couplings. Anchor's New Improved "Duloc" Reusable Coupling is featured for medium and low pressure service with "QW" (1-cotton, 1-wire, 1 cotton braid) and "QWR" (similar to "QW" but with rubber outer cover) Hose. These streamlined couplings are easily assembled and disassembled and are very conveniently installed, even in confined areas. No replacement parts are required when reused.

Other reusable couplings described are for Style "C" 2-Wire Braid High Pressure Hose; Style "F" 1-Wire Braid Medium and Low Pressure Hose; Style "HR" "HI-BURST" 2-Rayon Braid Hose and Style "R" Standard 2-Rayon Braid Hose for medium and low pressure use respectively. Anchor Clamp-Type Reusable Couplings are available in a wide range of sizes and styles for use with high, medium and low pressure hose, plus Spiral Wire Suction Hose, especially valuable for fast emergency field repairs.

New in the Catalog No. 303 are the recently introduced Anchor "Hold-Fast" Reusable Couplings designed for use with Anchor Style "PR" Rubber Cover, 1-Cotton Braid Hose and Style "PQ" Cotton Cover, 1-Cotton Braid Hose for low pressure service (maximum recommended working pressure—250 psi). These easily applied couplings are available in several styles for hose sizes ranging from ¼" ID to ¾" ID.

Copies of the new Catalog No. 303 are now available on request from Anchor Coupling Co. Inc., 330 No. Fourth St., Libertyville, Ill.

Circle **9** on Time-Saver Card

ANCHOR®...THE PLEDGE OF PERFORMANCE

IN HYDRAULIC TRANSMISSION LINES

Failure in a fluid power transmission line is usually costly, with expensive equipment down, production delays and idle manpower until repairs can be made.

To hold such breakdowns to a minimum, Anchor has not only established rigid quality standards to which all Anchor Hydraulic Hose Assemblies must conform, but makes frequent tests and inspections of materials and workmanship to ensure conformity to these high standards.

Because of this, the Anchor emblem on any piece of hydraulic equipment is a real "pledge of performance" and service.

Andy Anchor says:

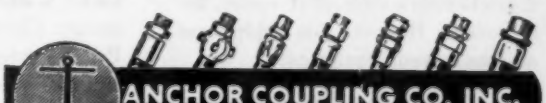
"Send for catalog describing the complete Anchor line!"

ANCHOR HOSE ASSEMBLIES with ANCHOR Pressed-On Couplings are available for high, medium and low pressure service with maximum working pressures ranging from 12,500 PSI for 3/16" I.D. 6 Ply Super Spiral Hose to 100 PSI for 2" I.D. Spiral Wire Suction Hose.

ANCHOR REUSABLE COUPLINGS — Regular or Clamp Type, are available for emergency repair and year-to-year superior performance for high, medium and low pressure service ranging from 5000 PSI for ¼" I.D. 2-Wire Braid Hose to 100 PSI for 2" I.D. Spiral Wire Suction Hose.

ANCHOR 4-BOLT SPLIT-FLANGE "O" RING HEAD COUPLINGS are available in a wide range of sizes for high, medium and lower pressure applications.

ANCHOR ADAPTER UNIONS, PIPE FITTINGS, SAE BOSS TYPE FITTINGS A complete line of Pipe and Tube Fittings, Adapter Unions and SAE Boss Type Fittings are offered in a variety of styles and sizes to satisfy the requirements of any installation.



ANCHOR COUPLING CO. INC.

329 North Fourth Street, Libertyville, Illinois

Branch Plants: Dallas, Tex., Plymouth, Mich.

Circle **10** on Time-Saver Card

FLUID POWER LINES

about hydraulics & pneumatics

AS MACHINE TOOLS GO . . . In this election year, political news spotlights focus on state primaries, Congressional maneuvering, speechmaking both major and minor, and all other activity that gives some insight into who will be the White House's next tenant. Similarly, fluid power designers can look to machine tools to learn where industrial hydraulic and pneumatic design is going.

Machine tools seldom require high force actions compared to forging presses, baling machines, marine steering gear, and other equipment that needs hydraulics' muscles; but they *do* need its easily variable speed control, stiffness, simplicity, economy, and efficiency. They get these characteristics in jobs from air chucking to tool slide actuation, clamping to spindle drive, counterbalancing to work handling.

Punched and magnetic tape, tracer control, and servovalves are familiar subjects to many machine tool designers. And their techniques should be studied by alert designers of all kinds of fluid powered equipment. Articles in this issue show where machine tool design is now, and where it's going. They give you a basic analysis of hydraulic servo performance, and an understanding of a servomechanism's vital nerve center, the servovalve. How can you apply these designs to your equipment?

WHY IS A BORING MACHINE LIKE A LATHE? . . . They both need closely controlled speed control, like the New Britain and Buhr machines written up in *How Two Machine Tool Manufacturers Control Speed*. We counted four different speed control methods used in these two machines.

HARVARD FROM MIT . . . Harvard B. Kolm, who wrote *Electrohydraulic Servovalves in Industry*, took his masters degree at Massachusetts Institute of Technology. He joined Moog Servocontrols in 1957 from Minneapolis-Honeywell where he worked on servovalve applications in military aircraft autopilots. Before becoming Manager of Moog's Industrial Division, he was a staff engineer responsible for system design and component development.

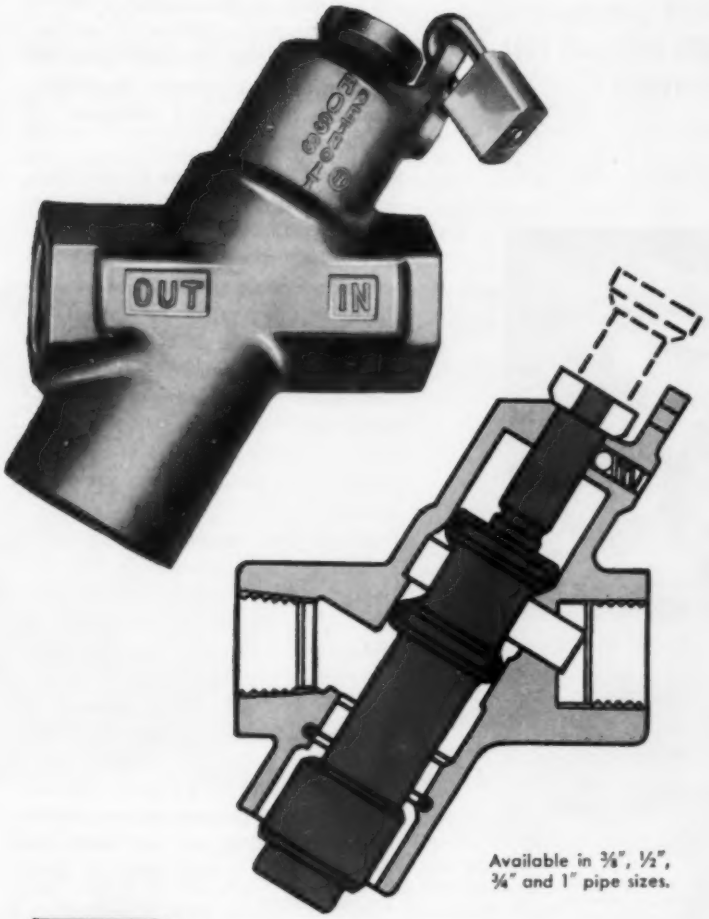
Kolm

ONE, TWO, THREE, STEP . . . Prompted, perhaps, by the old Lambeth Walk is the drill feeding circuit discussed in *Deep Drill Adjusts Advance Stroke and Depth* from Britain. As the hole gets deeper, this drilling system rapid advances the drill farther, from the top of the hole to the bottom, just before taking the next bite of metal.

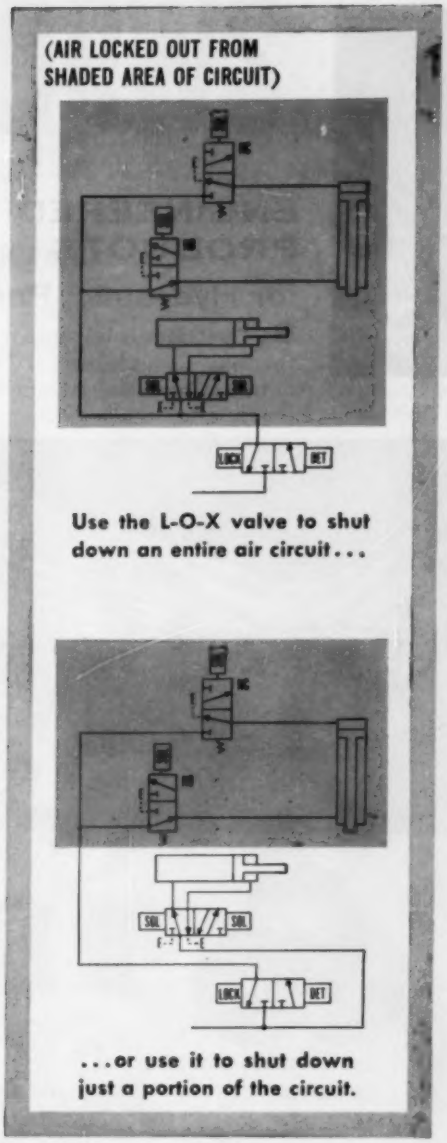
YOUR SLIP IS SHOWING . . . If your machine slows down as pressure builds up, you've got slip: some pressure fluid is sneaking back to tank through the pump. DoAll Company worried about this on their new hydraulic band saw until they came up with a slip compensator that changes pump displacement according to pressure.

LAST CALL . . . to get your share of $1,400 Prize Paper money. Closing date to enter the HYDRAULICS & PNEUMATICS Prize Paper Contest is July 1st. Write up on interesting hydraulic or pneumatic design, telling what the original objectives were and how they were achieved. For more details circle No. 240 on the time-saver card.

Lock out air for machine repair



Available in ⅜", ½", ¾" and 1" pipe sizes.


(AIR LOCKED OUT FROM SHADED AREA OF CIRCUIT)
LOCK
SET
Use the L-O-X valve to shut down an entire air circuit...
SOL
SOL
LOCK
SET
...or use it to shut down just a portion of the circuit.

Ross L-O-X VALVE

Now you can actually lock out air that operates a machine, as a safeguard when making machine repairs. The Ross L-O-X Valve installs in the supply line leading to the machine, upstream of any operating valve. It is so designed that when closed, supply-air to the machine is shut off and air downstream is exhausted. The valve can be *padlocked* in this position.

More L-O-X valves can be incorporated in the circuit to shut off and exhaust various segments of the circuit. Thus portions of the circuit can be available for maintenance service without shutting down the entire circuit. Detented in the open position, designed for very low pressure drop. Lightweight aluminum construction. Call your Ross representative or write for literature.

ROSS OPERATING VALVE COMPANY
105 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

Circle **119** on Time-Saver Card

ENGINEERED PRODUCTS

for Hydraulic, Pneumatic Service

Garlock "U" Cup and "V" Ring Packings (top) provide tight sealing, help increase efficiency of famous Tomkins-Johnson "Spacemaker" cylinders. Garlock molded cups (bottom left) and CHEVRON* Packings are also specified for air and hydraulic cylinders.

Tomkins-Johnson standardizes on Garlock "U" Cup and "V" Ring Packings for their famous "Spacemaker" air and hydraulic cylinders.

On a wide variety of "Spacemaker" applications, Garlock packings provide leak-proof service against air, water, and hydraulic fluids at temperatures to 250°F, pressures to 1000 p.s.i. Tomkins-Johnson specifies Garlock products because of their greater flexibility, minimum friction, and resistance to sudden shock loads.

Garlock "U" Cup Packings are specially designed for proper fit against the cylinder wall—this prolongs service life to a maximum. Available in several materials and designed to JIC standards, the cups are applied on diameters ranging from 1″ through 14″. Flexible and resilient Garlock "V" Ring Packings respond quickly to low gland and fluid pressures, offer positive, low friction sealing at all pressures. Available in various materials and sizes.

Enjoy the same advantages that Tomkins-Johnson does—standardize on Garlock hydraulic-pneumatic packings. Garlock's complete line also includes widely-used CHEVRON* Packings with an exclusive hinge-like construction that "rides" with the pressure . . . tightens as pressures increase, eases off as they decline . . . results in positive sealing with little friction. Garlock Molded Cups provide maximum efficiency in sealing air and hydraulic cylinders over a wide range of service conditions.

For more information, call your local Garlock representative at the nearest of our 26 sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalogs AD-163 ("U" Cup Packings) and AD-115 (CHEVRON Packings). Garlock Inc., Palmyra, New York.

Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Company

Order from Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products

*Registered Trademark

GARLOCK

Circle **47** on Time-Saver Card

Circle **99** →

. . . Fluid Power news

REPORT NO. 11,600 AID TO MACHINE DESIGN PROGRESS

From Oilgear Application-Engineering Files

HOW OILGEAR ENGINEERING TEAMWORK AIDS MACHINE DESIGN PROGRESS

CUSTOMER: Rockford Machine Tool Company

DATA: Application of Fluid Power system to planers that mass-duplicate the airfoil on new, solid, forged steel propeller blades. Six years has been spent on the development and manufacturing methods to produce this new blade. Planers to be equipped with tracer attachments to machine blades from master templates. Desired profile is completely machined to proper thickness . . . maintaining accurate airfoil on both sides of blade. Requirements: extreme accuracy; flexibility of control; elimination of shock, vibration and gear marks on work; independent, fast cutting and return speeds to keep costs to a minimum.

SOLUTION: Shown above are 20 Oilgear-equipped, Rockford Hy-Draulic planers machining aircraft propeller blades. Closeup (right) shows how Rockford's hydraulically operated "Kopy-Kats" can mass-duplicate four of these new-type, steel blades simultaneously from master templates. Rockford Machine Tool says of this set up, "The inherent advantages of hydraulic drive and control make this gigantic installation an extremely powerful production unit. Hydraulic drive is a natural for reciprocating machine tools. It's being proven daily in the world's finest machine shops." This is but *one* example of the ever increasing application of Oilgear-equipped machine tools. Rockford, and other designers and builders of tools for industry, have discovered that Oilgear *Application-Engineering* means cooperation and teamwork in supplying new production requirements . . . that Oilgear is more than just an "off-the-shelf" source of supply . . . that Oilgear is a Fluid Power design and engineering service based on over 35 years of pioneering and knowledge in precision, "Any-Speed" control, and efficient linear and rotary power systems. Because of this cooperative teamwork in solving problems—coupled with progressively engineered, trouble-free, dependable, Fluid Power control and drive systems—manufacturers have come to trust and depend upon Oilgear . . . the name that protects and enhances "OEM's" reputation, and assures satisfied users.

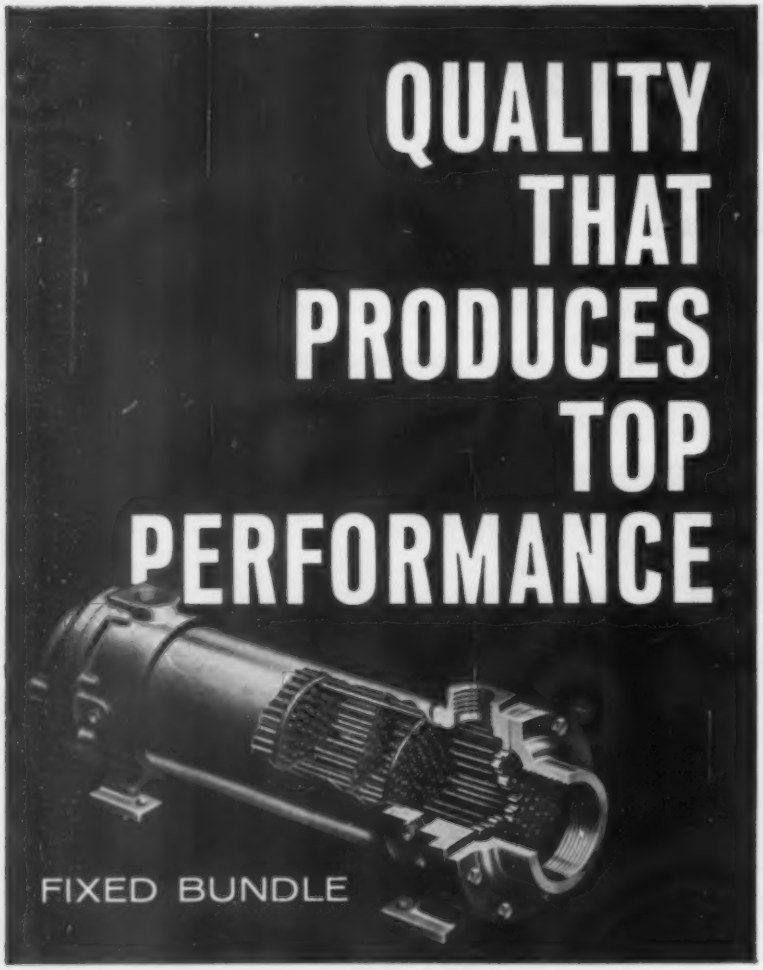
For practical solutions to YOUR *linear or rotary drive and control problems, call the factory-trained Oilgear application-engineer in your vicinity. Or write, stating your specific requirements, directly to . . .*

THE OILGEAR COMPANY

Application-Engineered Fluid Power Systems

1564 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

Rockford Machine Tool Company has used thousands of Oilgear Fluid Power Systems on planers and slotters since 1928, because of: 1: No costly high inertia, reversible, electric motors; complicated control systems, and reduced power consumption and vibration. 2: No racks, screws, gear trains. 3: Infinite speeds from 10 to 300 fpm, with 3 cutting force ranges-independent maximum return speed. 4: Shock-free, instant reversals for efficient short or long stroke cutting. 5: New, complete flexibility in operational control.



Yates-American

HEAT EXCHANGERS

- Flanged baffles . . . pioneered by YA eliminate vibration wear and provide maximum efficiency.
- Rolled tube joints . . . industry accepted standard of quality construction.
- Single and Multiple Pass Designs . . . available in 2" through 10" diameters.
- Now available from stock.
- Ask for Bulletin HT-1A.

ENGINE COOLING RADIATORS

Over 75 years of service to industry

HEAT TRANSFER DIVISION

Yates-American

MACHINE COMPANY

705 4th St. BELOIT, WISCONSIN

Circle **140** on Time-Saver Card

LETTERS to the editor

Address your letters to: Editor, HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

How fast a valve?

TO THE EDITOR:

For a special machine with a number of pneumatic cylinders we have to predetermine the cycling time. The difficult part in this task is to find the time between actuation of the valve and completion of a certain length of stroke of the piston.

Are there any charts available on the response of standard valve-cylinder combinations, or is there any literature at all on this subject?

The suppliers of valves or cylinders, whom we have approached so far with our problem, could not give us a satisfactory answer. Therefore we would appreciate it very much if you could inform us on this matter.

A. W. TOBBER
Vice President, Eng. & Mfg.
Harrington Tool & Die Co. Ltd.
Montreal, Canada

The article "How to Determine Valve Response" which appeared in our October 1959 issue, will give you some information.

Nylon Fittings

TO THE EDITOR:

In your April issue, on page 70, you refer to an all-nylon compression type fitting. Also on this page is a photograph entitled "Nylon Flare Fittings".

If you can provide us with the name and address of either the manufacturer and/or user of these nylon fittings, it will be appreciated. In fact we would appreciate the names of all known manufacturers and/or users of plastic fittings.

RICHARD C. SHAW
Richard C. Shaw Advertising
Garrettsville, Ohio

Names of manufacturers of plastic fittings have been sent.

Continued on page 14

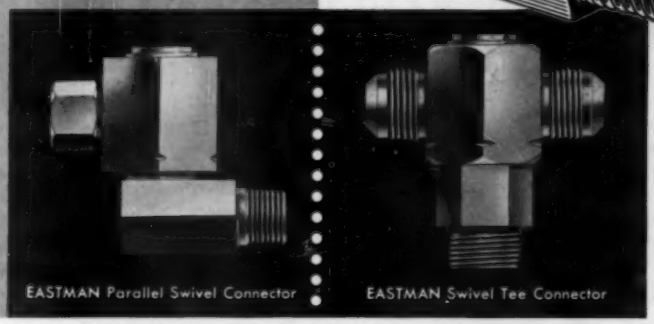
Eastman

improves INDUSTRIAL SWIVEL CONNECTOR

Licensed Under
Pat. No. 2481404

AMAZING VERSATILITY AND ADAPTABILITY!

These two adaptations, specified by two of America's largest major equipment manufacturers, reveal the unique adaptability and versatility of EASTMAN'S improved Industrial Swivel Connector.



EASTMAN Parallel Swivel Connector

EASTMAN Swivel Tee Connector

improves **SEALING QUALITY**
through use of SIX seals, thereby eliminating failure from grit, dust and other foreign materials.

improves **SERVICE LIFE**
through new design and engineering, the interior is chrome-hardened with a highly polished mirror finish.

improves **UNIFORMITY OF FLOW**
at any angle of the swivel by undercutting the shaft to equal diameter of the orifice.

improves **SERVICEABILITY**
through shorter, more compact housing; saving weight. Hex design permits multiple tapping on housing; easier assembly.

While the use of EASTMAN'S High Pressure Industrial Swivel Connector eliminated the cause of hose failure due to constant, extreme flexing, it tended to increase the load on the swivel connector.

To improve the performance of the swivel itself, EASTMAN engineers improved its internal design, chrome-hardened its interior surfaces, cadmium plated the shaft and then machined them to a mirror-like finish.

Satisfactory service under the most unfavorable field conditions was insured by increasing sealing rings from four to SIX: 2 leather dust seals, 2 synthetic back-up washers and 2 quad rings of oil-resistant rubber (−65° to +250°).

Exhaustive tests at 3000 p.s.i., through one million cycles, with the hydraulic fluid *saturated* with abrasives, dirt and other foreign materials, proved EASTMAN'S Industrial Swivel Connector satisfactory in every respect and did not cause failure of any kind.

That is why America's leading OEM's and replacement buyers specify *complete* EASTMAN Hydraulic Hose Assemblies . . . for improved design, quality manufacturing and exhaustive testing. It pays to specify EASTMAN.

STANDARD SIZES AND COMBINATIONS AVAILABLE

LOW TORQUE—Freedom from friction, even under high pressure.

WIDE RANGE—Operating pressures up to 5000 p.s.i. trouble-free operation through wide temperature range (−65° to +250°).

ROTATION—Full 360° for all manifolds.

SIZES—Steel, plated for corrosion protection—½", ¾", 1", 1¼".

Other sizes available on request.

LOOK INTO EASTMAN'S IMPROVED SWIVEL CONNECTOR—WRITE TODAY!

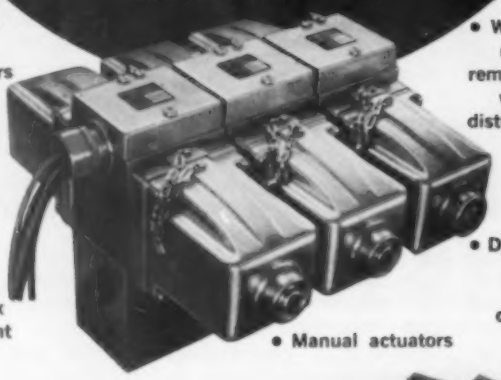
Please send me Bulletins 100 and 200 on low, medium and high pressure assemblies.

Eastman MANUFACTURING COMPANY
DEPT. AH-6, MANITOWOC, WISCONSIN

*NEW!

BECKETT HI-CYCLIC

3/8" DIRECT ACTING SOLENOID VALVE FOR MANIFOLD MOUNTING



- Compact—mounts on 2⅝" centers—up to 5 units on a manifold.
- When multiple mounted can remove an inner valve without disturbing wiring of other valves.
- Built-in electrical junction box—vapor-tight seal.
- Direct solenoid operated—industrial, constant duty type.
- Manual actuators

TYPE:

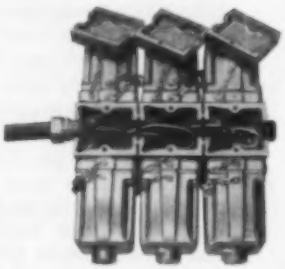
⅜" capacity double or single solenoid, spring return — fast reaction for accurate control.

2, 3, or 4 way, 2 or 3 position.

7 spool types available to meet all requirements.

Furnished with standard equipment or to JIC standards.

MEDIA:
Air, vacuum and all conventional hydraulic fluids.



- With junction box covers off, valve design provides wide open conduit for easy installation of wiring. All wiring readily accessible.
- Solenoid and junction box covers chained to valve body.

NFPA MEMBER

WRITE TODAY FOR DETAILED INFORMATION

DISTRIBUTORS IN MAJOR CITIES COAST-TO-COAST AND CANADA

BECKETT-HARCUM CO.

981 W. LOCUST STREET, WILMINGTON, OHIO

Circle **21** on Time-Saver Card

LETTERS

Price please

TO THE EDITOR:

In the January 1960 issue of your APPLIED HYDRAULICS & PNEUMATICS Magazine you published a list of the various text books on hydraulics and pneumatics. Unfortunately the titles were given without price quotations. We should ask you therefore to let us know the price for the book "Determination and Correlation of Flow Capacities of Pneumatic Components" by D. H. Tsai and M. M. Slawsky, National Bureau of Standards.

Thank you for your cooperation.

A. STEINMULLER
Entwicklungsring Sued
Munich, Germany

We do not have prices on this book. We suggest you write to the Superintendent of Documents, Washington 5, D. C.

Low speed motor

TO THE EDITOR:

We are currently investigating the availability of high efficiency hydraulic drive components for construction equipment. One of the items in which we are highly interested is a low speed hydraulic motor which would develop approximately 60 hp at 10 rpm. Any data that you can provide will be greatly appreciated.

R. A. MCCULLOUGH
Manager—Product Planning
Blaw-Knox Co.
Pittsburgh, Pa.

To our knowledge, there is no fluid motor available which will give good efficiency and smooth operation at 10 rpm delivering 60 hp. To do this, a motor would have to operate at very high pressure to limit size. The article "High Torque Motor Has Radial Crank Design" which appeared in the November issue shows one fluid motor design for this service. We have also sent the name of a manufacturer offering motors for this service. ▼▼▼

Denison and Denison HydrOILics are registered trademarks of Denison Eng. Div., ABSCO

DENISON HydrOILics

DENISON hydraulic equipment powers 21 hatch covers and anchor windlasses aboard new "Export Agent"

CONTROL

60 Series Fluid Motor

500 Series Constant Volume Axial Piston Pump

60 Series Variable Volume Axial Piston Pump

***"EXPORT AGENT"**... new 10,210 ton cargo ship built by the National Steel and Shipbuilding Co., San Diego... incorporates precise, reliable Denison hydraulic equipment to power hatch covers and anchor windlasses.*

FIRST of the new replacement fleet for *American Export Lines*—the "Export Agent" is designed to carry over 643,000 cubic feet of general cargo. Largest and fastest cargo vessel now operated by *A.E.L.*—this ship is equipped with many new cargo handling devices... including 21 hydraulic hatch covers, powered by Denison hydraulic equipment.

The hatch cover system—built by Greer Marine, Inc., Catasauqua, Pa.—incorporates 500 Series Denison constant volume pumps. Operation is fast, simple and safe. *Result: Important time savings* in cargo handling plus minimum cargo damage in bad weather.

In addition, the anchor windlasses—supplied by The Hyde Windlass Co., Bath, Maine—are powered by Denison 60 Series handwheel-controlled variable volume axial piston pumps and fluid motors. Maximum fluid motor speed is 1150 rpm. Output of the pumps is 120 gpm at 1200 rpm. *Result: Precise, accurate control and reliability* for the anchor windlass system.

Denison hydraulic equipment is engineered to deliver low-cost fluid power for every marine need—steering systems... cargo handling... winch and windlass drives. Your nearby Denison Hydraulic Specialist can help you save time and money on *your* next marine hydraulics problem. Write for details.

DENISON ENGINEERING DIVISION
American Brake Shoe Company
1166 Dublin Road • Columbus 16, Ohio

HYDRAULIC PRESSES
PUMPS • MOTORS • CONTROLS

DENISON
HYDRAULIC POWER

POSITIVE AUTOMATIC PRESSURE CONTROL?

CHECK YOUR REQUIREMENTS AGAINST FULFLO SPECIFICATIONS

- ✔ Screw or flange models
- ✔ Pressures to 500 pounds
- ✔ Pipe sizes to 3"
- ✔ Steel, cast iron or brass bodies
- ✔ Brass, steel or stainless trim
- ✔ All-steel for extra safety

FULFLO gives you what you want in safe, trouble-free and quiet operation for any hydraulic system. Shear-closing action eliminates chattering; sliding piston gives full flow opening; distinctive construction allows easy adjustment within the valve's pressure range or change of the pressure range.

Whatever your requirement . . . for O.E.M. use or replacement service . . . there's a FULFLO Oil By-Pass Relief Valve designed just right, built right and priced right, too!

NEED A "Special"?

FULFLO can engineer a special valve to your most exacting requirements. Examples of "specials" are shown in Data Book.

FOR EXTRA CONVENIENCE

Where frequent pressure setting adjustment is needed, install a FULFLO Hand Wheel Valve. Made in a variety of styles.

FOR COMPLETE INFORMATION, request a copy of the FULFLO Valves Mechanical Data Book with complete specifications and engineering data.

"FULFLO"

THE FULFLO SPECIALTIES CO., INC.

415 Fancy Ave. Blanchester, Ohio

Circle **46** on Time-Saver Card

FLUID POWER FORUM

Each month HYDRAULICS & PNEUMATICS surveys readers for their experiences and opinions in fluid power design.

● *Are you using straight-thread tube and hose fittings? Do these seal with an O-ring or a metal-to-metal fit? What are the advantages you've gotten with them? If you're not using them now, are you planning to in the future?*

We will be using some hydraulic or pneumatic cylinders in the next few months on some of our shop tools, which we have designed. We will be glad to tell you of our experience when these units have had a chance to prove themselves.

W. B. COLITRE,
Reydun Knife & Machine Co.
Fulton, N. Y.

Up to the present we have used very little hose in our plant. Our primary means of machine activation has been electric rather than pneumatic. Consequently where fittings are used, they have been specified and supplied by subcontractors. Some of these have O-rings, some metal to metal fittings. There are both straight thread and taper thread fittings.

LARRY M. RENTSCHLER
Polymer Corporation of Pa.
Reading, Pa.

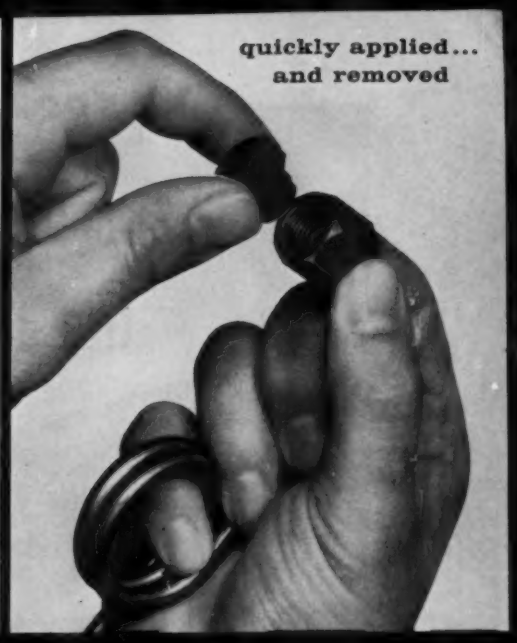
We are distributors of hydraulic and mechanical power transmission equipment. As such we do quite well with tube and hose fitting sales. While we do little in straight-thread hose fittings, we do have a fair volume in tube fittings. About the best type of straight-thread fitting we have come across is the type that offers a readily compressible, confined nylon, acting as a primary seal, and a substantial metal to metal contact with the port surface creating the secondary seal. The

Continued on page 18

Circle **109** ➔

product saving protection

eye appeal that adds sales appeal



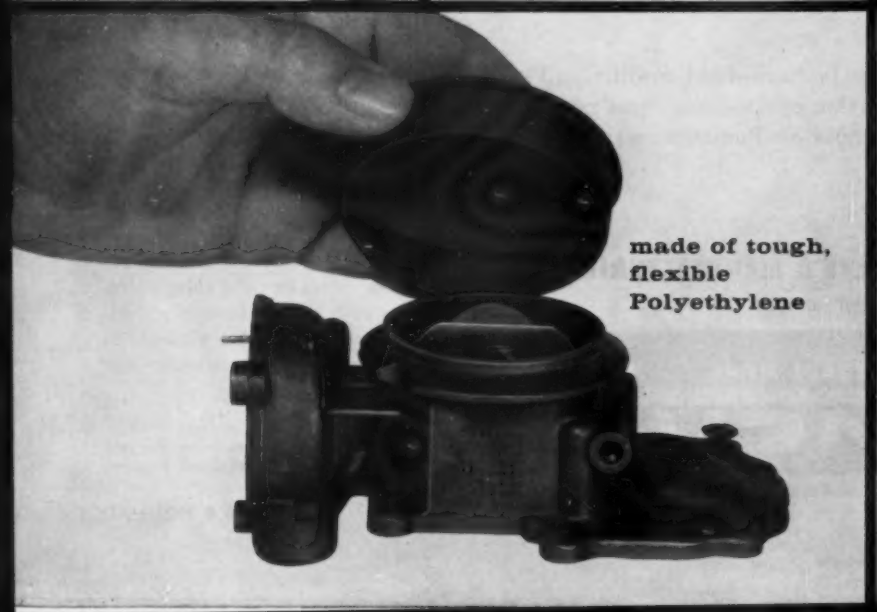
quickly applied... and removed

won't chip, break, shred or collapse

save time, trouble and $$$

Caplugs

need some soon? over 600 sizes in numerous styles and colors now in stock.



made of tough, flexible Polyethylene

"kid glove" protection for tubing, threaded fittings and machined parts in process, storage and transit...get a kit full of samples in exchange for the coupon below.

CAPLUGS DIVISION,
PROTECTIVE CLOSURES CO., INC.
2203 Elmwood Ave., Buffalo 23, N. Y.

MAIL a free assortment of Caplugs, literature and prices to us, without obligation.

Name

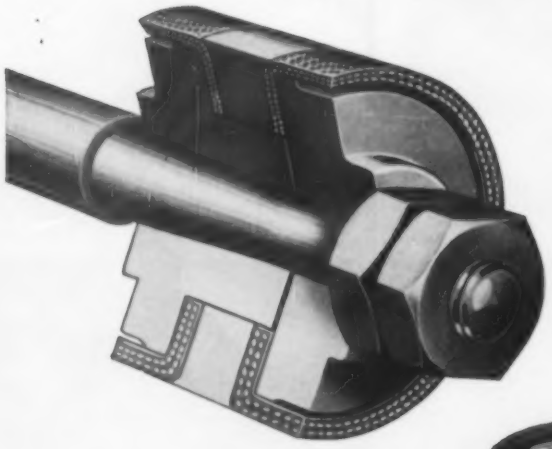
Title

Firm

Address

City Zone State

LESS FLUID SLIPPAGE!
LESS DOWNTIME!
GREATER EFFICIENCY!



...in hydraulic and pneumatic mechanisms, reciprocating pumps

Darcova Pumcup

Darcova 45° Bevel Type Pumcup

THE BIG DIFFERENCE you'll find in Darcova Pumcups is that they operate at full efficiency *throughout their entire life.* This means fluid slippage is virtually eliminated.

And because fewer replacements are necessary, you have less downtime. Users report that Pumcups *outlast ordinary packings at least 3 to 1!*

Pumcups are available in three textures—hard, medium and soft. Also in regular or 100% nylon composition. Sizes range from ¾" to 20". For all the facts on Pumcups, write for Bulletin **5903.**

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP
TRADE MARK
PUMCUPS

Circle **35** on Time-Saver Card

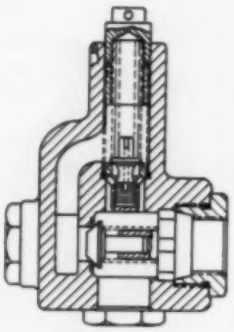
FORUM

nylon material offers a definite advantage in that it will not extrude or creep. It also outperforms any rubber compound. In using the O-ring type of fitting with rubber O-ring, it is often necessary to match the O-ring material to the fluid seal.

G. AVON, JR.
Hydra-Mech, Inc.
South Bend, Ind.

● *Have you been troubled by shock? How have you reduced it? —accumulators, decompression, deceleration valves, special directional valves or circuitry?*

The valve we developed—shown in this drawing—has shown good results especially for mobile purposes. It is principally built up of



two relief valves and two check valves, and for double acting cylinders. Pressure up to 2000 psi.

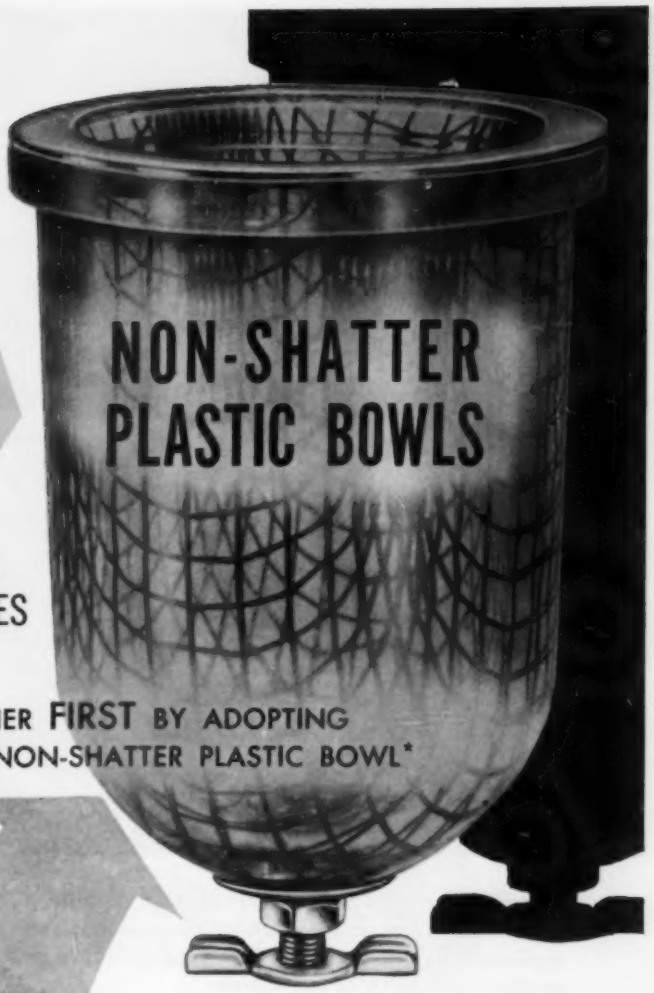
LARS ASKERLUND
Monsun AB
Sundbyberg, Sweden

Yes, we have been troubled by shock and have reduced it by: accumulators on working lines (transfer machines i.e.) in all cases; deceleration valves, if necessary, when the cycle needs it; restrictor valves on pilot valve ports, to improve the mildness of travelling of the main valve plunger, to eleminate shock on working circuit.

RENE POUDRA
Automobiles Peugeot
Montbeliard, France

NEW

for AIRLINE FILTERS,
LUBRICATORS, DRAIN TRAPS,
and COMBINATION ASSEMBLIES



Arrow PIONEERS ANOTHER FIRST BY ADOPTING
THE NEW NON-SHATTER PLASTIC BOWL*

SAFETY FIRST

In the event of Bowl Breakage the imbedded wire cloth molded in the high tensile bowls prevents shattered pieces of the broken bowl from flying about to cause possible injury to plant personnel in the immediate area.

*Developed and Manufactured by
The Safety Crafters Corp.
Palatine, Illinois

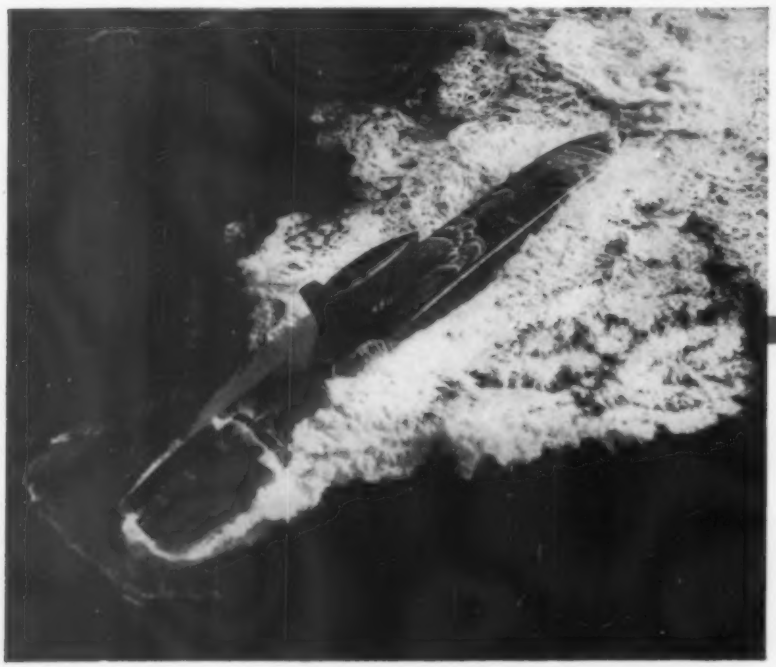
Arrow TOOLS, INC.
1934 S. KOSTNER AVE. • CHICAGO 23, ILLINOIS

THE HYDRAULIC ...another

HOUGHTON
THE ONLY
COMPLETE LINE OF
PACKINGS & FLUIDS
FOR
INDUSTRIAL HYDRAULIC
SYSTEMS

Fortified Houghto-Safe fire-resistant hydraulic fluid is used in Polaris missile launching systems in atomic submarines. Houghton VIX-SYN synthetic rubber packings are also used in these submarines.

FIRE-RESISTANT HYDRAULIC FLUIDS



Houghton Houghto-Safe fortified fluids were among the first fire-resistant synthetic hydraulic fluids developed for industry and Navy carriers and missile handling and launching equipment. Now available in a wide range of water-glycol, phosphate ester, and water-oil emulsion formulations, fortified Houghto-Safe fluids (and compatible packings) meet almost any types and degrees of fire-hazardous applications.

ENGINEER

man who knows how much HOUGHTON KNOW-HOW helps!

In the Houghton Line, there's a full range of new, as well as old, established hydraulic fluids and packings to improve most any hydraulic process. But *making* these products is only half the Houghton story.

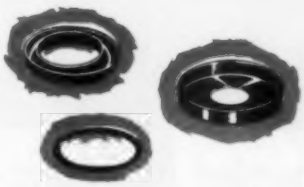
More important is Houghton's ability to make them *work for you* . . . just as they are doing for the U.S. Navy . . . job-tailoring each to fit your particular application. Most important, Houghton gives you the benefit of many years of experience and research in all areas of hydraulics to help solve the immediate problem in yours. That's the unique niche Houghton has carved for itself all over the world. And it's one where our leadership has never been challenged.

Near you there's a Houghton Man whose broad hydraulic know-how and on-the-job-'til-it's-done service is yours with every item in the Houghton Line. He's a good man to have on your team. Call him or write E. F. Houghton & Co., 303 W. Lehigh Avenue, Philadelphia 33, Pa.

HYDRAULIC OILS AND ADDITIVES

Houghton Hydro-Drive oils, fortified for high oxidation stability, solvent action, corrosion resistance, rust prevention and film strength, are well known for their low cost, trouble free performance in hydraulic applications. In closed water systems, Houghton Hydrolubric added to the water has provided lubrication and rust protection for the entire system.

HYDRAULIC PACKINGS



Leadership in packings standardization is one reason major hydraulic equipment manufacturers consider Houghton "packing headquarters". Houghton is also the only manufacturer who offers a *complete* line of *both* packings and fluids for any industrial hydraulic system . . . your guarantee of a completely unbiased recommendation.

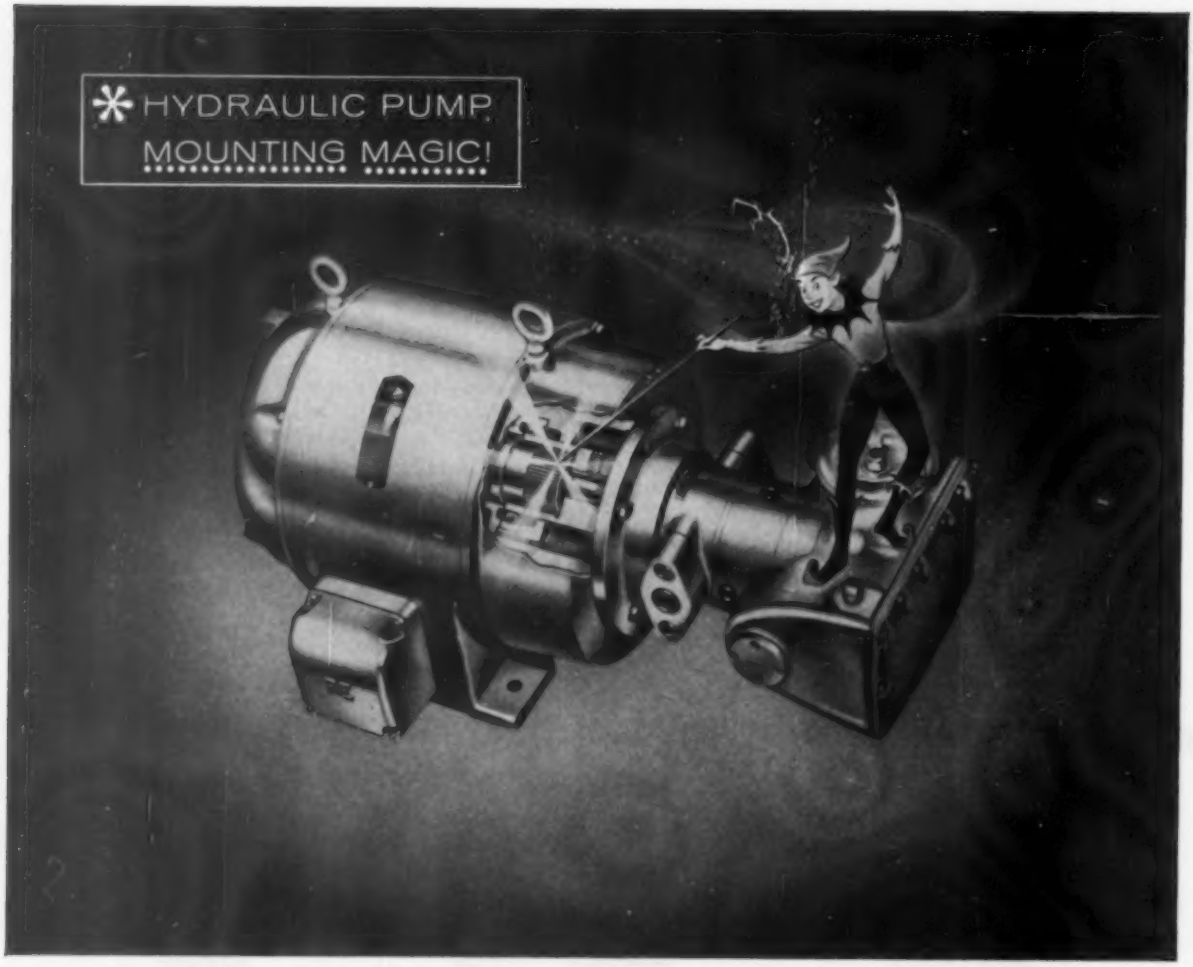
ON-THE-JOB SERVICE...

. . . the most valuable help Houghton can give you. More than 100 Houghton sales engineers are backed by skilled laboratory and field technicians, all experts in their fields. Our 96-year reputation rests on the ability and integrity of these men who are truly your Partners in Production.

Industry's Partner in Production

E. F. HOUGHTON & CO.

Philadelphia, Pa. • Chicago, Ill. • Carrollton, Ga. Detroit, Mich. • San Francisco, Calif. • Toronto, Canada



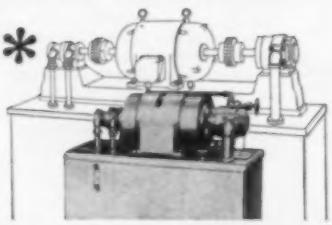
REULAND spline-coupled hydraulic pump mount motors

...CUT SPACE NEEDS ALMOST 50%...AVAILABLE *NOW* IN ½ H.P. THROUGH 50 H.P.!

Pump and motor become *one* with the new Reuland spline-coupled hydraulic pump hook-up. The pump shaft is connected directly to the motor's shaft *inside the motor*. Flexible couplings are eliminated... pump mount platforms are eliminated... and the tank length can be reduced because almost 50% less mounting area is required. Compact appearance is beautiful.

SPEEDY INSTALLATION

Pump-to-motor hook-up is merely a matter of seconds. All you do is slip the spline coupling onto the pump shaft...and attach the pump to the endbell. This spline coupling is supplied with the motor and is precision mated for each make of pump. There's no time wasted tinkering around...takes only a fraction of the ordinary time.



PRECISION ALIGNMENT

Alignment is perfect *automatically* whether the installation is made out in the field or on the production line. This permits even unskilled workmen to handle this simple task without error. Also, by hooking the pump up at the point of bearing support, within the motor, vibration is reduced to a new minimum. Operation is smooth, quiet.

COSTS LESS...SAVES INSTALLATION LABOR... FITS ALL PUMPS...FILLS ALL POWER NEEDS—

½-50 H.P. The Reuland spline-coupled unit is priced lower than a conventional set-up ...saves you extra money by reducing installation costs. What's more, we can supply it to fit any make of pump you may be using...and to your *exact* power needs, from ½ h.p. through 50 h.p. So sure are we that it will be of help to you, we are offering to engineer a demonstration unit to your equipment, without the slightest obligation. These units are our best salesmen.

Our New General Catalog Will Come In Handy—Sent Free on Request.

Refer to Sweet's Product Design File, Section 5a

MODERN POWER FOR MODERN-DAY PRODUCTS

REULAND MOTORS

REULAND ELECTRIC COMPANY
WESTERN DIVISION: Alhambra, California
EASTERN DIVISION: Howell, Michigan
DISTRIBUTORS IN ALL PRINCIPAL CITIES

*Trademark Registered

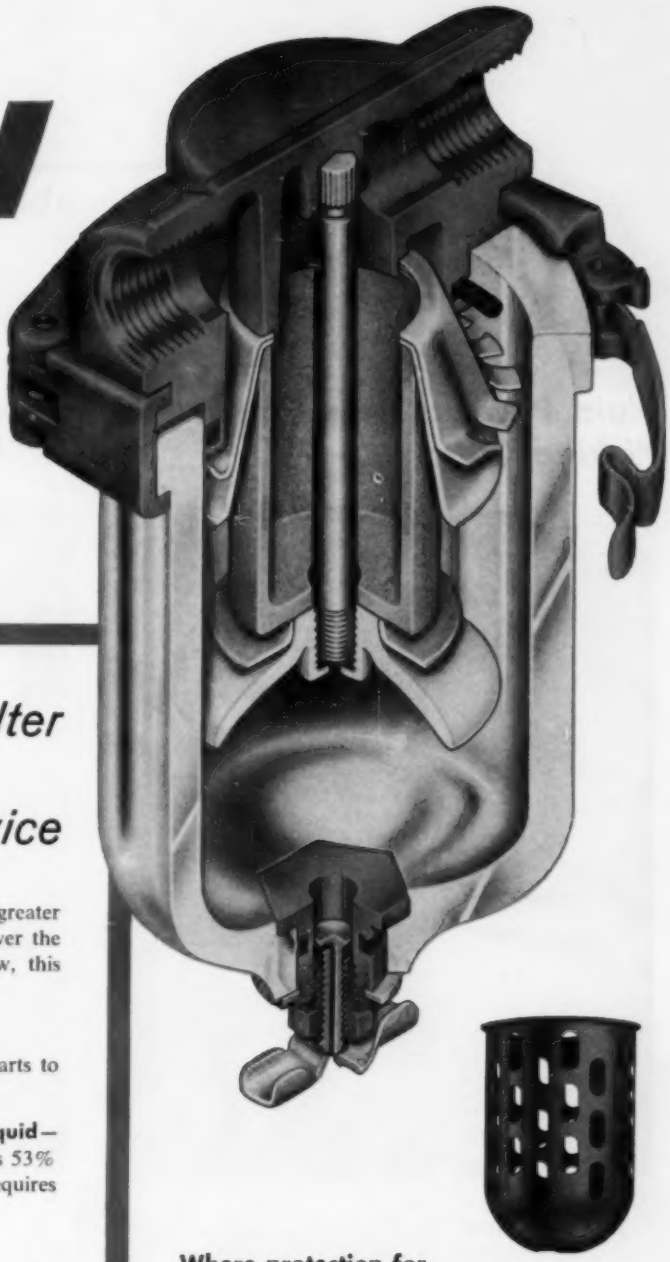
Announcing

NEW

Norgren

COMPRESSED AIR LINE FILTERS

for ¼", ⅜" and ½" pipe sizes



The most efficient filter you can buy...
the easiest to service

1 **100% liquid removal—**
Improved Norgren design provides a greater than ever liquid removal efficiency. Over the entire range of recommended air flow, this filter effectively traps all liquids.

2 **Easier and quicker to service—**
No tools needed and only 4 separate parts to handle.

3 **Larger bowl capacity for collected liquid—**
The "quiet zone" below the baffle holds 53% more collected air-line contaminants. Requires less frequent draining.

4 **New improved bowl—**
New, stronger transparent bowl has greatly improved resistance to fatigue failure.

PLUS *these important benefits:*

- **Highly effective removal of solids.**
- **Optional interchangeable filter elements—** 74, 64, 25 or 5 micron.
- **Reduced service time**—the simplest, easiest filter to disassemble and clean.

Where protection for transparent bowls is required,
a metal bowl guard, held in place by the clamp ring, is available.

For complete information about Norgren's complete line of manual drain and automatic-drain compressed air line filters, call your nearby Norgren Representative, listed in your telephone directory—or WRITE FOR BROCHURE NA-1.

FOUNDED IN 1926

C. A. NORGREN CO.

3402 SOUTH ELATI STREET • ENGLEWOOD, COLORADO

BRIEFS

about fluid power

Fluid Power Keeps Cotton Pickers Picking Cotton

To keep 2500 cotton picking machines harvesting the San Joaquin Valley crop, Kern County Equipment Co. in Bakersfield has put hydraulics and pneumatics to work in their overhaul shop.

Spindles which pluck cotton from the bolls are carried on an endless conveyor (left photo) and positioned under a press cylinder for disassembly. The machine distributes disassembled parts into waiting repair bins. Limit switches on the hydraulic ram start and stop the conveyor. The switches also operate a pneumatic cycling cylinder, which shifts a 4-way hydraulic valve that actuates the press cylinder.

Another machine (right photo) can both assemble and disassemble spindles. The rotating table holds 24 spindles. It positions them under the press cylinder. The piston takes a punch-out disassembly tool or a press-on assembly tool. To rotate the table, a 1⅛" hydraulic cylinder strokes 4" to engage rim slots on the table. A limit switch at the end of piston travel trips a valve solenoid to actuate a registry pneumatic cylinder. This cylinder seats a V-head in an awaiting rim slot. Registration is accurate to ±.005". The registry cylinder then engages a limit switch, which triggers the press cylinder. After a press-cycle, a limit switch reverses the registry cylinder. Exhaust air from the cylinder blows a hinged plate which knocks a spindle nut into a parts chute. Another pneumatic exhaust tube blows remaining spindle parts from one of the receiving holes on the table. The press-cylinder's up-stroke limit switch triggers the table-rotating hydraulic cylinder, to begin another sequence. ▼▼▼

Continued on page 26

Circle 63 →

Compare what the **PDQ WILL DO...**
Compare the **PDQ PRICE...**
With any other air valve...

a ½" valve that will do a ¾" valve job at a ⅜" valve price

- ☑ Accessibility
- ☑ Simplicity
- ☑ Speed and Capacity
- ☑ Price and Quality

What will the PDQ do? It will do a ¾" valve job. It has faster response time and greater capacity than valves twice its size and four times its weight. To repack you simply replace 2 self-contained units in less than a minute. You can change valves on the line in less than 30 seconds.

Will the PDQ last? The PDQ has a short stroke, and a light but rugged aluminum construction with built-in wear compensation. Anticipated valve life is conservatively estimated at 35 million cycles . . . on most applications this is **years** of trouble-free service. Coil (properly applied) is unconditionally guaranteed for the life of the valve.

How about the price? The PDQ is a ½" valve at a ⅜" valve price. Write us today.

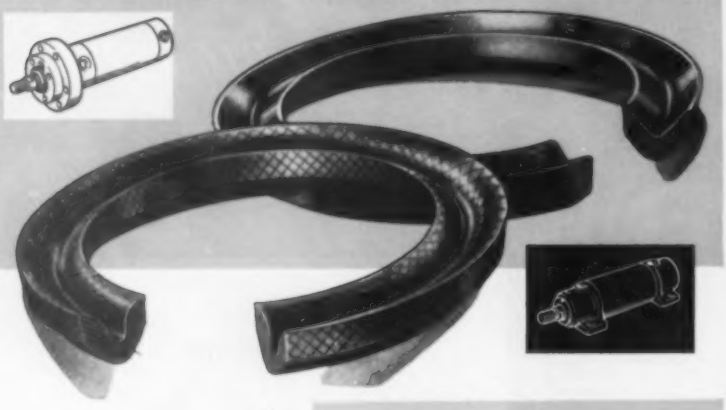
A. V. Ney

A. V. Ney, Sales Manager

HUNT VALVE COMPANY · SALEM, OHIO, U. S. A.

HUNT V C ***Quick-As-Wink*** AIR & HYDRAULIC CONTROL VALVES

DESIGN ESSENTIALS FOR BETTER HYDRAULIC PACKINGS



THESE BASIC FEATURES are part of "John Crane" Hydraulic Packings. They assure packings that meet the most rigid requirements of hydraulic service ...a good initial seal, long life, efficient performance over wide pressure ranges and stability in the fluid medium.

1. Pressure access allows immediate pressure distribution and packing response.

2. Ball joint nesting surfaces facilitate breathing without pinching, wedging or lip collapse.

3. Adequate lubrication reservoir.

4. Uniform bottom thickness eliminates weak points and insures centerline hinge action.

5. Molded-in lip interference insures tight static seal and conformation to bore and rod deflections.

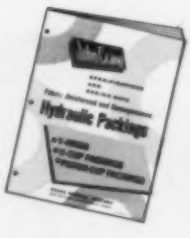
6. Heel clearance prevents "riding" at heel and eliminates lip toe-in.

7. The fabric in the "V" rings is so laid to assure maximum strength—an important consideration for maximum packing life.

Tell us about your standard requirements and ask for recommendations and/or assistance in the creation of a combination of packings that will best handle individual operating conditions. Request Bulletin P-333 for general information.

Crane Packing Company, 6405 Oakton Street, Morton Grove, Ill. (Chicago Suburb).

In Canada: Crane Packing Co., Ltd., Hamilton, Ont.



John Crane

MECHANICAL PACKINGS · SHAFT SEALS · TEFLON PRODUCTS · LAPPING MACHINES · THREAD COMPOUNDS

CRANE PACKING COMPANY

Circle **33** on Time-Saver Card

BRIEFS

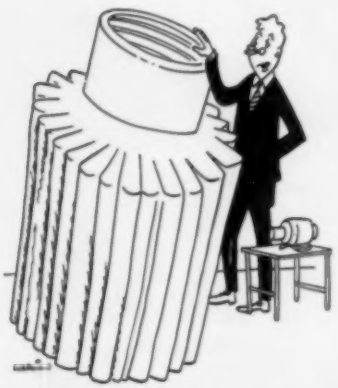
NCIH Program Takes Shape

CHICAGO—John Pippenger, conference director for the 1960 National Conference on Industrial Hydraulics has been guiding a committee of engineers to plan the October 20-21 meeting.

Design for Cleanliness in Fluid Power Systems is this year's Conference theme.

More than twenty papers will be presented at 12 sessions. Among the speakers will be engineers from International Harvester, The Martin Company, North American Aviation, Thompson-Ramo-Wooldridge, Socony-Mobil, and Minneapolis-Honeywell.

Papers will emphasize designs of hydraulic and pneumatic systems and components for equipment throughout industry. More than 800 engineers will attend this 16th annual conference. It's sponsored by Illinois Tech with the cooperation of many professional engineering societies. ▼▼▼



Now that we've developed a filter that works we just have to beat the size problem to make it ready for the sump!

Hydraulics Powers Car Parker

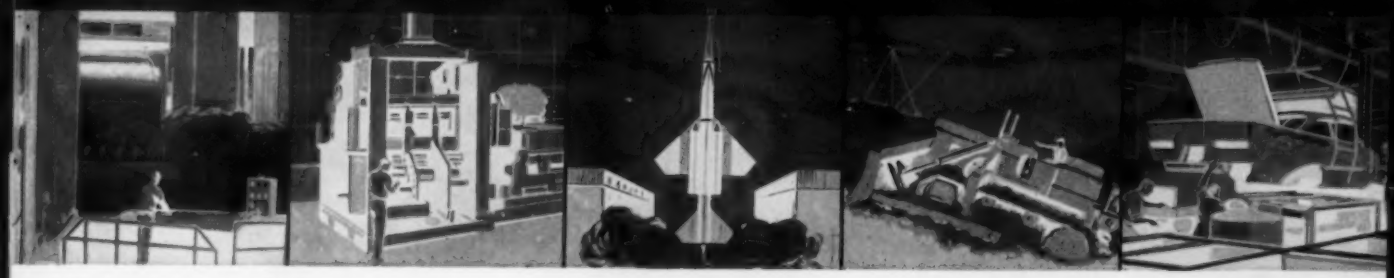
A hydraulic power unit moves a platform which can park a car in less than a minute. No one drives the car. A dolly on the platform

Continued on page 30

Circle **11** →

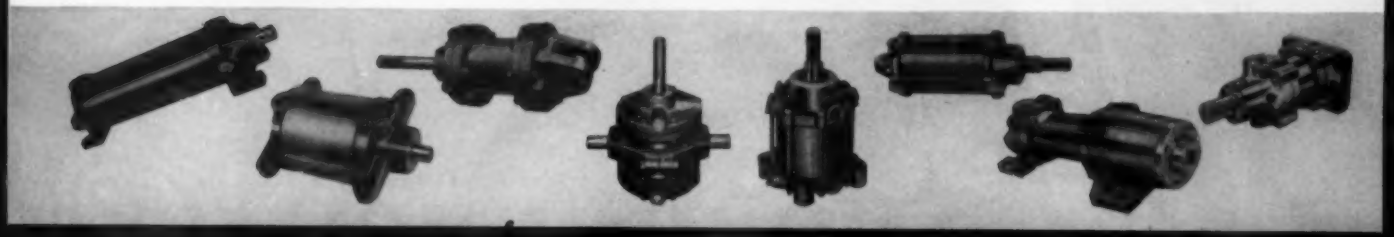
Experience proved in every major industry . . . ANKER-HOLTH

POWER CYLINDERS SAVE YOU TIME, TROUBLE AND MONEY

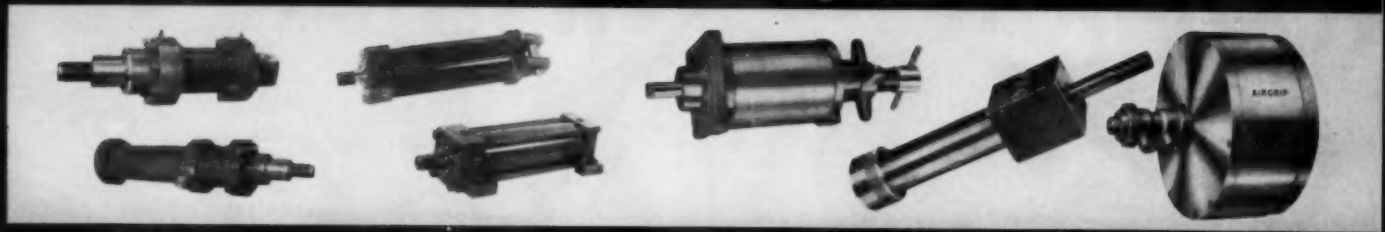


Select your needs

from the World's Widest Selection of Standard Cylinders



Check these compelling reasons why Anker-Holth air and hydraulic power cylinders save you time, trouble and money – widest selection of standard models | reliability through military accepted quality control program | simplified maintenance | all mountings available | bores 1" to 30" | strokes to 40' | built to JIC specifications | nationwide engineering service on call | complete facilities to engineer any power cylinder application outside the standard model.



Only a few models could be shown above

This free catalog shows them all

ANKER HOLTH

DIVISION, THE McDOWELL-WELLMAN COMPANIES

Send this B-1

ANKER-HOLTH DIVISION
THE WELLMAN ENGINEERING COMPANY
2723 CONNOR STREET, PORT HURON, MICH., U. S. A.

Name_____

Company_____

Address_____

PREVENTIVE
MAINTENANCE

The one sure way to reduce high hydraulic operating costs in hazardous installations

Over 500 million machine hours of operation proves the SAFETY, ECONOMY and RELIABILITY of Pydraul fire-resistant fluids in hydraulic systems of all types.

Prevent hazards . . . with *double-action* fire resistance! Pydraul straight-synthetic fluids will not flash or ignite in active contact with ignition sources—not even when sprayed through a 6000°F. oxyacetylene torch flame (AMS-3150B, 4.9.3.2, and MIL-F-7100). Eliminates worry about explosions or disastrous fire due to ruptured lines or leakage on hot equipment. And Pydraul protects a *second* way . . . doesn't evaporate to leave a flammable residue that could be ignited *after* a leak or line break.

Prevent high maintenance costs . . . with Pydraul *preventive maintenance* protection. Pydraul lubricates like a premium-grade petroleum oil, and has much greater stability than any water-based fluid. Pydraul is 100% synthetic . . . contains no water to cause chronic maintenance troubles. Pydraul doesn't wear out in use; doesn't sludge, to clog filters, strainers or orifices; doesn't corrode metals; doesn't cause rusting. Pydraul F-9, A-200 and 625 operate to 300°F. with low vapor pressure.

Many users report they've never had a bearing fail since switching to Pydraul. Pumps and valves have been in service for eight years without changing.

Prevent erratic production . . . by converting to stable Pydraul. One major manufacturer made a careful full-year comparison of Pydraul and a water-glycol fluid . . . in identical die-casting machines making the same part. *Pydraul cut down-time adjustments per machine from 49 to only 6 and reduced annual maintenance costs by 67.4%!* Production rates went up, to give even greater savings.

If you now use any water-based fluid, Pydraul can lower your maintenance costs, increase your production reliability . . . with these preventive maintenance properties: **• better lubricity under heavy loads • better oxidative stability • better thermal stability • better foaming resistance • lower vapor pressure • compatibility with oils, greases.**

with PYDRAUL®

CONVERSION to Pydraul is simple and inexpensive. Choose from these Pydraul straight synthetics to meet your needs:

PYDRAUL A-200, F9	PYDRAUL 150	PYDRAUL 625	PYDRAUL 60	PYDRAUL AC
Medium-weight fluids for standard indoor industrial hydraulics. Top performance. Pydraul A-200 is new, low-cost straight synthetic.	Light-weight fluid for outdoor use. Operates in 0° F. weather.	Heavy-weight fluid for heavy-duty applications. Designed for pumps demanding high viscosity fluid (800-1000 SUS).	Low-viscosity fluid for precision equipment or very low temperatures —down to minus 20° F.	Air compressor lubricant that prevents carbon build-up on valves, protects against fires and explosions.

Pydraul fluids give you the fire protection you need . . . without the penalty of excessive maintenance costs

Monsanto®

Please send me these new brochures:

"Know Your Fire Hazards"

"Preventive Maintenance in Fire-Resistant Hydraulics"

Technical literature on Pydraul F-9 ( ), A-200 ( ), 625 ( ), 150 ( ), 60 ( ), AC ( )

Monsanto Chemical Company, Organic Chemicals Division Industrial Fluids Department, St. Louis 66, Missouri

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ STATE _____

Circle **95** on Time-Saver Card

VERSATILE,
LONG WEARING,
SLOW AGING

TECHNICAL MEMO ON LINEAR COMPOUNDS 7441-50 & 7446-70

. . . for U-cups, O-rings and other seal configurations

- especially designed for service in hydraulic fluids, lubricating oils and automatic transmission fluids
- good recovery properties, excellent wear resistance
- fully effective sealing from −40° to +212°F; can be used intermittently to +325°F in oil

MATERIALS COMPATIBLE WITH THESE COMPOUNDS:

Alcohol • Corn Oil • Cosmoline 1058 • DTE Oil • Ethylene Glycol • Freon 11 • Freon 12 • G.E. #10 Transformer Oil • Gulf Pride • Gulf XB Grease • Hexane • Houghto-Safe 271 • Hydrolube • Lard • Larex • Lubricating Oils • Lubriplate • MIL-F-25558A • MIL-G-4343 • MIL-H-5606 • MIL-L-9000 • MIL-L-15016 • MIL-L-15017 • Mineral Base Hydraulic Oils • Mo Par Fluid • Olive Oil • Penzoil Trans Oil • Prestone • Sea Water • Shell #532 • Shell Iris 902 • Shell Donax T6 • Shell Northia #41 • Shell Tellus #33 • Shell Tellus #41 • Socony Vactra Oil • Solvivis • Soybean Oil • Sunisо #4 • Sunisо #7 • Sunoco Dynalube • Suntac #201 • Ucon LB-300X • Ucon 200 N • Univolt #35 • Velocite #1 • Water

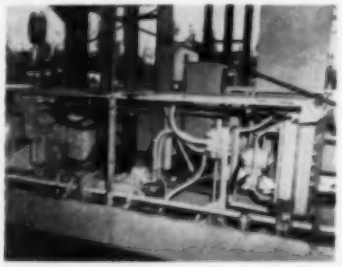
For complete technical data—including list of incompatible materials—Request Bulletin 56703-1. Linear Inc., State Road and Levick St., Philadelphia-35, Pa.

PERFECTION IN RUBBER
LINEAR
LINEAR Inc. STATE ROAD & LEVICK ST. PHILA. 35, PA

Circle **81** on Time-Saver Card

BRIEFS

picks up the car, and the operator takes it to the proper level and spot. The platform is suspended from cables which go over a grooved wheel at the top of the car parker. The cables run from this



wheel to a deflecting wheel, then down to an iron counterweight.

A variable-volume piston pump moves the platform by traction drive. A hydraulic motor is connected to a gear reducer, which drives the grooved wheel. Pump volume controls platform speed.

The parker is a product of Pigeon-Hole Parking, Inc., Spokane. Manufacturer is The Peters Co., Portland. ▼▼▼

Cleveland Society to Present Inventions Exhibit

The National Inventions Exhibition & Creativity Conference, June 20-24, will present inventions, ideas, and processes where they will be seen by those who can use them. The sponsoring Cleveland Engineering Society will conduct a series of meetings to elaborate on the theme of "Ideas and Profits." The speaker for the first session will tell why we need new ideas, new machines, and new processes. The seconds day's meeting will cover "What is Needed." Other sessions will concern patents, the techniques of invention, and future inventions. For more information, write Creativity Conference, Cleveland Engineering Society, 3100 Cleveland Ave., Cleveland 14, Ohio. ▼▼▼

Continued on page 32

Barksdale AIR-SEAL* Valves for the nerve centers of production

** The air pressure is the sealing force; the higher the pressure, the tighter the seal.*

DIRECT SOLENOID 4-way, 3-way, shut-off and diverter valves

♦ Standard **AC**

Explosion-proof **AC** ♦

♦ Standard **DC**

Explosion-proof **DC** ♦

SOLENOID-PILOT 4-way and 3-way valves

♦ Standard **AC**
♦ Standard **DC**

Explosion-proof **AC** ♦
Explosion-proof **DC** ♦

MOMENTARY CONTACT solenoid-pilot valves

♦ Single Solenoid

Both types available in standard AC and DC and explosion-proof AC and DC.

Dual Solenoid ♦

MANUAL OVERRIDES for standard solenoid-pilot valves

♦ "L" type manual override

"MK" type manual override ♦

MANUAL and FOOT OPERATED valves

Manual 4-way

Manual shut-off

Foot operated 4-way

Write for air valve catalog (AV-9) which contains complete data and prices on 562 different valves (not counting voltage variations).

CONTROL VALVE DIVISION

barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

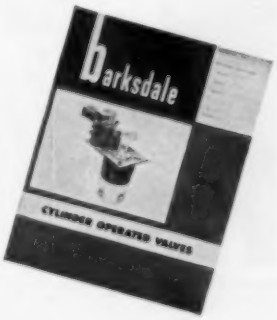
Circle **16** on Time-Saver Card

CYLINDER OPERATED "SHEAR-SEAL" VALVES

Remote control operators for 10000 P.S.I., 6000 P.S.I. and 3000 P.S.I. "Shear-Seal" Valves are available with cushioned or non-cushioned cylinders.

4-Way, 3-Way and Shut-off valves range in pipe sizes from ¼" to 1½" N.P.T.

For complete data request catalog COV-60-61.



CONTROL VALVE DIVISION

barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **17** on Time-Saver Card

AIR He N

COMPRESSION to

12,000 psi

...discharge capacities to 150 scfm

with

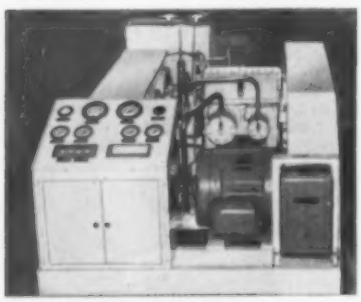
CARDAIR
CENTRAL COMPRESSION SYSTEMS

New Technical Data and Catalog. See offer below.

Cardair Central Compression Systems (completely packaged, semi-portable)—are today handling air and a variety of gases—helium, nitrogen, argon, etc.—at pressures ranging from 4,000 to 12,000 psi with discharge capacities from 50 to 150 scfm. Even hydrogen is being safely compressed to elevated pressures.

Systems can be provided from stock with *guaranteed* purification of delivered gas to —100°F. dew point and less than 4 ppm oil content. Specially engineered systems to meet your particular requirements can be supplied from standard components.

This ability to control hard-to-handle gases, proven by years of exacting rocket and missile service, offers unlimited possibilities to industry—not only for testing and laboratory work, but also for actual production.



Model PB-CCS—*One of a wide selection of systems* 4-stage air-cooled Compression System—Pressure Range: 6,000—12,000 psig—Induction: 65 to 135 psig—Capacity: 75 scfm N_2 and Air; 70 scfm He—Guaranteed Gas Purity: —100°F. Dew Point, less than 4 ppm oil content.

FOR YOUR FREE CATALOG, clip this to your signed letterhead and mail to:

CARDAIR

DIVISION OF MARMON-HERRINGTON, INC.
Dept. 16, 207 N. Michigan Ave., Chicago 1, Ill.
WESTERN STATES DISTRIBUTOR:
General Air Equipment
824 Hollywood Way, Burbank, Cal.

Circle **27** on Time-Saver Card

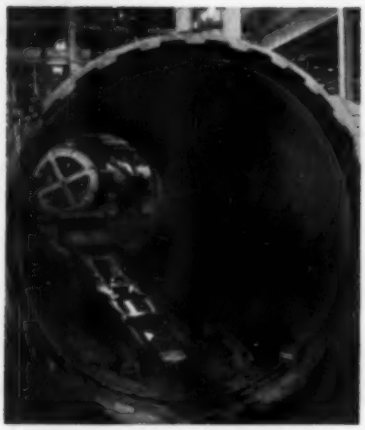
BRIEFS

How Fluid Power Lines Are Made

Goodyear's North Chicago hose plant has a production capacity of 10,000 miles of hose a year. Uses of the hoses include automotive braking, power steering, and compressed air handling.

HIGH-TEST WIRE for hydraulic hose reinforcement is wound onto braider bobbins.

REINFORCEMENT IS BRAIDED on in the same way children braid a Maypole. The machine shuttles the bobbin carriers around the hose.



PRESSURE COOKER HOLDS 7000 ft. of 1" hose. The men are rolling reels of hose off the dolly which runs on tracks into the steam-jacketed heater. The hose cures at 300 deg for an hour. Then it's taken off the reel for inspection.

AUTO BRAKE HOSES get final inspection. Girl at left inspects outer jackets and packs hose. Girl in background checks wall thickness. Two on right cut hoses to proper length. Before cutting, every length of brake hose is placed under 1600 psi hydraulic pressure.

Centrifugal Pump Manual

Centrifugal Pump Application Manual has been published to help users select the proper equipment. It treats centrifugal pump principles, viscosity effects, cavitation and suction lift, temperature rise, packings and seals, installation, and trouble-shooting. The manual's 227 pages include over 50 illustrations, charts, and

Continued on page 36

Circle **30** →

ANOTHER NEW
PRODUCT OF

C/R

BULLETIN SS-100

SCOTSEAL*

A new concept in oil seal design!

Integral sealing surface prevents major causes of leakage

It is now generally recognized that major causes of leakage among shaft type oil seals are: improper handling before assembly, damage by the assembler or shaft during installation, and improper shaft finish. Experts say surface finish of from 5 to 15 microinches is most desirable —but this is often prohibitively expensive.

The C/R SCOTSEAL precludes any possibility of damage by handling, installation, or shaft finish because the *sealing lip does not touch the shaft!* C/R's development of SCOTSEAL's integral, self-contained sealing surfaces assures you of reliable performance unsurpassed by the finest machined shaft surfaces.

HIGH PERFORMANCE OPERATION
Field tests have shown that this new C/R SCOTSEAL:

- SEALS WITH GREATER EFFICIENCY
- RUNS COOLER WITH LESS FRICTION
- DELIVERS GREATLY INCREASED SERVICE LIFE
- ELIMINATES SHAFT SCORING
- PREVENTS SEAL LIP DAMAGE AT ASSEMBLY
- REDUCES ASSEMBLY AND REPLACEMENT COSTS

UNIQUE DESIGN The C/R SCOTSEAL is designed and constructed to seal within itself. In effect it is a self-contained oil sealing cartridge. This sealing cartridge consists of two parts which have relative motion to each other. In the illustration above, the outer Unit (A) is an encasing member. A portion of the inner surface of this shell serves as the surface against which the sealing member runs. The inner unit (B) is the metal reinforced, bonded synthetic rubber sealing member. In the external design, illustrated, the sealing member pushfits over the shaft and becomes a part of it—actually moving *with* it—and the metal case or shell pressfits into the housing bore. On internal designs, the sealing surface pushfits on the shaft and the sealing member is contained in the shell which pressfits in the bore.

PRE-LUBRICATED Since the sealing element is enclosed, prelubricant applied during fabrication stays in place and lubrication is supplied to the sealing lip through centrifugal action, giving extra protection particularly during starved conditions. Where the seal will be exposed to considerable dirt and water, a dirt lip is provided. Also, drain holes can be provided in the shell adjacent to the dirt lip. Centrifugal force will then sling dirt and water out . . . keeping the C/R SCOTSEAL as free as possible from abrasive elements.

ECONOMICAL Significant savings or cost reductions can be realized with the C/R SCOTSEAL. Where normal lip-type seals ideally require a shaft surface finish of 5 to 15 microinches and minimum hardness of Rockwell C30, no special finish or hardness is required for the SCOTSEAL. Shafts need not be specially hardened, ground and polished over the area where the seal contacts the shaft. Nor are wear sleeves shrink-fitted on the shaft required. All of these operations are eliminated when the C/R SCOTSEAL is used. The savings in machining costs alone will more than offset the slightly higher first cost of the seal. And there is no possibility of lip damage in installation. Additional dependability and quality will accrue to your assembly in the minds of the end-user. There will be no scored shafts to remove and refinish. Replacement of the SCOTSEAL, if necessary, is a quick, simple procedure. Thus, equipment downtime and maintenance costs will be reduced.

APPLICATION The C/R SCOTSEAL is currently providing increased sealing efficiency and extended service life on truck, bus and trailer axles. Its advantages indicate application wherever a high production run is involved; where oil retention is difficult; and where equipment downtime and replacement costs are critical. In broad terms, the SCOTSEAL may be used wherever an oil-tight press is possible.

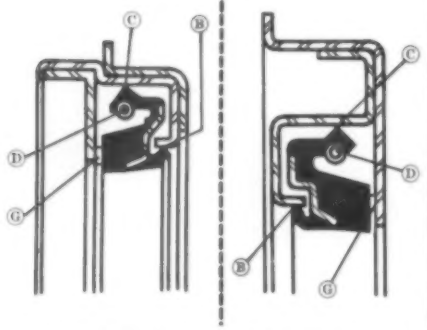
(SEE ILLUSTRATIONS ON OTHER SIDE)

* Self Contained Omnipurpose Type SEAL. Trade Mark

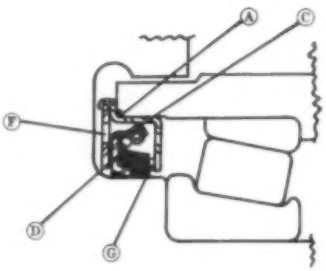
Shaft Type Scotseals...

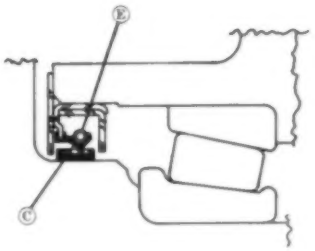
The versatility of the basic C/R SCOTSEAL concept is illustrated below. Note the many different configurations, as well as material combinations, that can be developed, all embodying the self-contained principle, but fitting ideally the requirements of various applications.

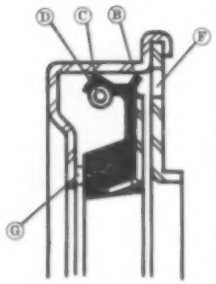
TYPICAL INSTALLATIONS...SEALING BEARINGS



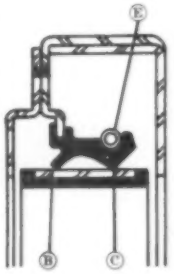
External Type SCOTSEALS



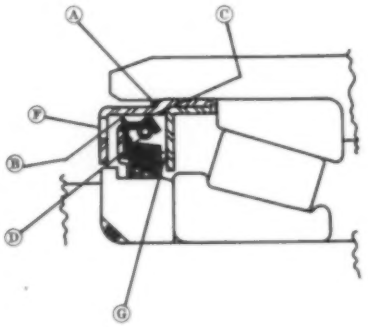


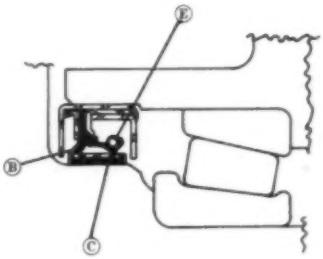


External



Internal





LEGEND: **(a)** Sirvene Gasket **(b)** Dirt Lip **(c)** Sealing Lip **(d)** Expanding Spring **(e)** Contracting Spring **(f)** Drain Hole **(g)** Chaplets—keep sealing element spaced axially within its shell to insure proper installation.

Investigate this seal further. It will reduce costs for you and the ultimate user of your equipment where large production quantities are involved, and leakage, downtime and replacement are critical factors. C/R Oil Seal engineers will gladly recommend the correct C/R SCOTSEAL design for your application. Get in touch today.

CHICAGO RAWHIDE MANUFACTURING COMPANY

1301 Elston Avenue — Chicago 22, Illinois

In Canada: Chicago Rawhide Mfg. Co. of Canada, Ltd., Brantford, Ontario
Export: Geco International Corp., Great Neck, New York

Copyright 1960 by Chicago Rawhide Mfg. Co.

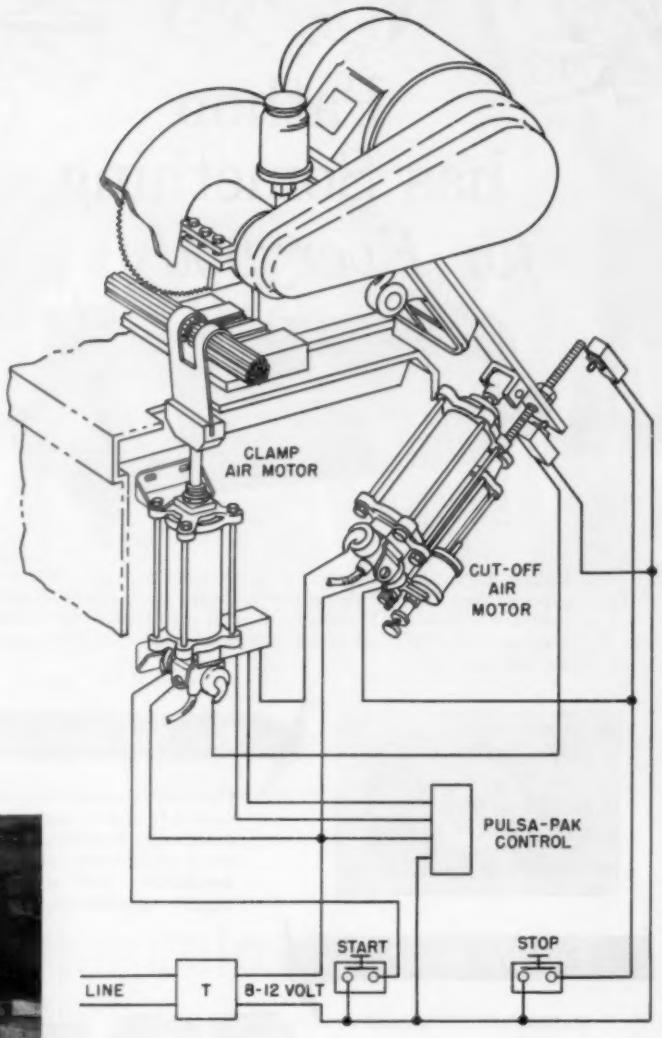
Printed in U.S.A.

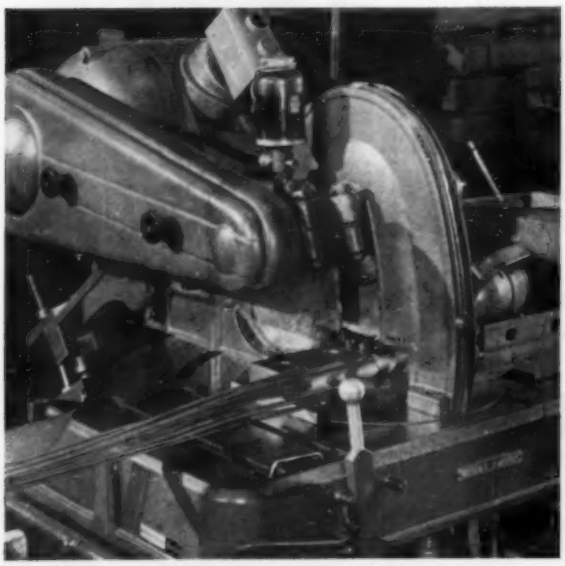
HOW TO MAKE A CUT-OFF SAW PRODUCE MORE AT LESS COST

Shown at the right is a SPOT-A-MATION IDEA used in many plants. Almost invariably it has meant cost savings of 50% or more—has improved product quality, lengthened saw life, lessened worker fatigue.

Two Bellows Air Motors are used. One, hydraulically controlled, feeds the saw through the work The second clamps the work in position. The two Air Motors are electrically interlocked. The cut-off saw can be made completely automatic by adding a third Air Motor to feed the material.

This is another typical way Bellows Air Motors are used to "Spot Modernize" existing equipment. Almost any hand-fed, or hand-controlled machine can be made to produce more, at less cost, with versatile Bellows "Controlled-Air-Power" Devices.





Typical application of this SPOT-A-MATION IDEA in the plant of Milwaukee Gas Specialties where gas tubing is cut to length. Here costs were cut better than 50% and cost of rejected material reduced 20%.

12848-3

THIS SPOT-A-MATION IDEA FILE IS YOURS ON REQUEST

Contains drawings, circuit diagrams, equipment list, and full details to enable you to convert existing equipment to lower cost operation. Write for it today No obligation.

Address Dept. AH-660, Bellows-Valvair, Akron 9, Ohio.

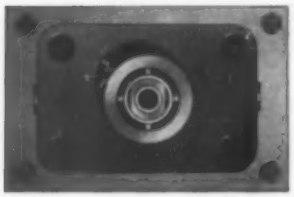
Bellows-Valvair

The Bellows Co. • Valvair Corp. Akron 9, Ohio

DIVISIONS OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

Pathon has Something *for Everybody*

Pathon Cylinders are designed to give you a highly practical cylinder that fits into almost every situation where a hydraulic cylinder is needed. Maintenance is at an absolute minimum because Pathon Cylinders are simple and easier to take apart and put together.

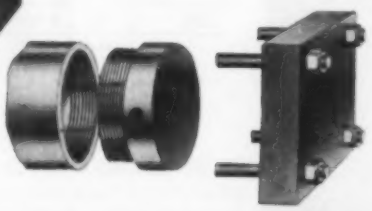


For the Designer

Pathon's compact design saves valuable space, makes your designing job easier, and gives your equipment added dependability with a modern rugged appearance.

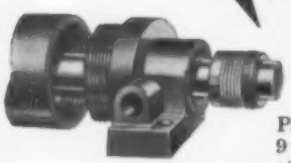
For the User

Pathon's screw thread head design gives you up to 40% more strength than most tie-rod cylinders. This increased strength means less maintenance, longer life.



For the Maintenance Man

Rod packing and bearing is externally replaceable and any part can be replaced without complete disassembly and the resulting "basket full of parts."



Pathon Hydraulic Cylinders are available in 9 mounting types, thirteen bore sizes—1⅛", etc., through 14", and three Series—for 1000 PSI, and 2000 PSI and 3000 PSI.

Write for Bulletin No. 22-A

Pathon MANUFACTURING COMPANY

3823 PACIFIC AVE. • CINCINNATI 12, OHIO

FLUID OPERATED AND CONTROL EQUIPMENT

Circle **104** on Time-Saver Card

BRIEFS

tables. Publisher is Buffalo Pumps Div., Buffalo Forge Co., Dept. 5, 490 Broadway, Buffalo. Price is $5.00.

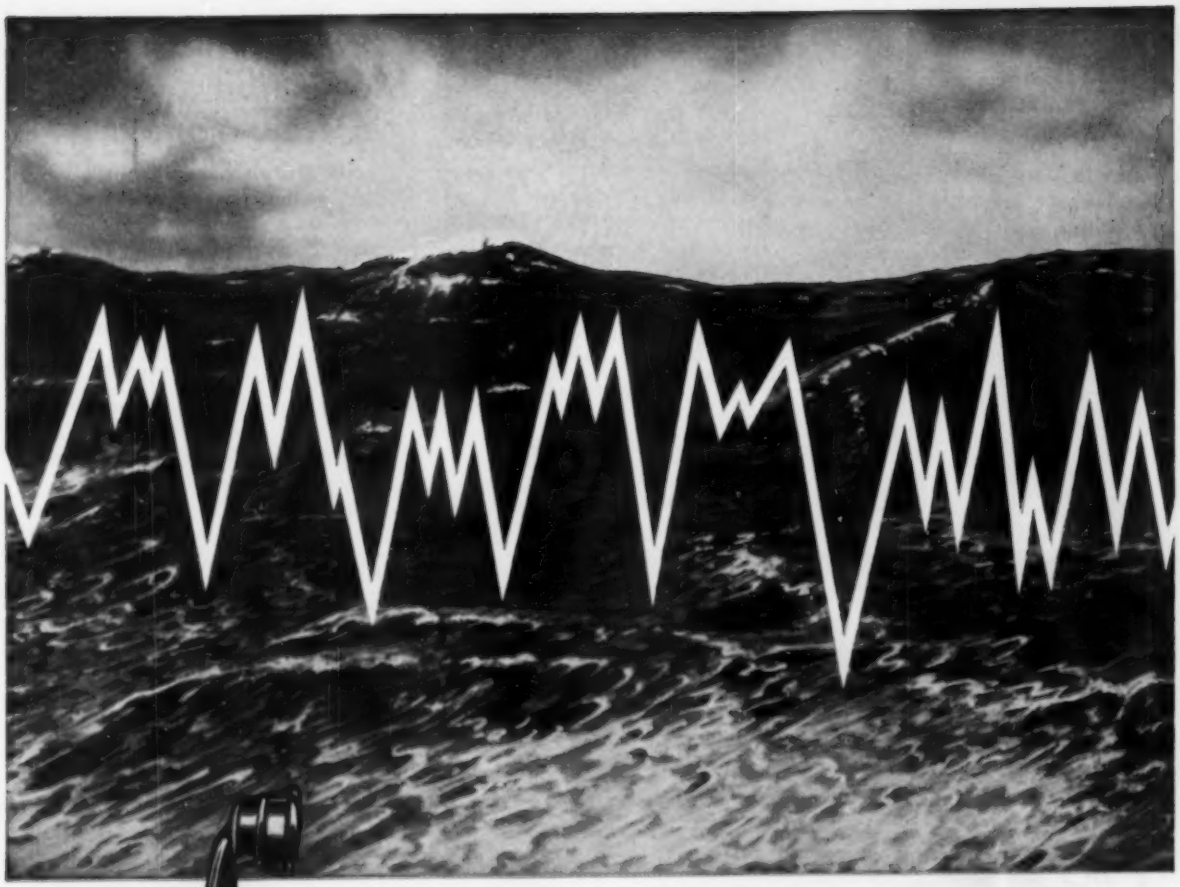
MIT to Give Summer Course on Fluid Power

The Massachusetts Institute of Technology will offer a two-week special summer program on fluid power control from June 14 through June 24. It will summarize the most important concepts in fluid power control and discuss recent developments. Fresh analytical and experimental data will be explored for new applications.

The program will cover fundamental concepts of fluid flow, pneumatic jet-pipe characteristics, reaction-jet servomotor development, flapper-valve stability, pressurized gas bearings, hot gas generation and utilization, hydraulic and pneumatic servomechanisms, control valve con-

Continued on page 38

SPEAKERS AT THE HIGH-PRESSURE HYDRAULICS Seminar sponsored in April by Milwaukee School of Engineering include Robert Alexander, chief of the Mechanical Equipment Branch, U. S. Army Engineer Research and Development Laboratories, Ft. Belvoir, Va.; William Bohannan, project engineer, product design, Denison Engineering Div.; Wesley Master, director of engineering and sales, Dynex, Inc.; Ralph Palmer, sales engineer, Racine Hydraulics and Machinery, Inc.; and Allan Morris, editor, HYDRAULICS & PNEUMATICS. Russell Henke, chairman of the MSOE Advisory Committee on Industrial Hydraulics, was instrumental in setting up the one-day program. The seminar informed engineers of innovations in high-pressure (3000-6000 psi) hydraulics.



Telecommunications

Two recent major steps in the improvement of world telecommunications have been the laying of the first Trans-Atlantic and the California–Hawaii submarine telephone cables.

When laying cable either on a flat sea bed or over underwater mountain ranges, the exact control of paying out speed and tension in the cable is of paramount importance. 'VSG' variable delivery oil hydraulic pumps are used to act as brakes on the cable, which is drawn out of the ship by its own weight. This enables a very smooth and regulated control to be maintained or instantly varied to suit ship speed, paying out speed and tension in the cable.

It is just another of the highly varied applications of 'VSG' variable delivery pumps and transmission gears which have now been serving modern industry for over fifty years.

'VSG'

Regd Trade Mark

SERVING MODERN INDUSTRY

VICKERS ARMSTRONGS (ENGINEERS) LTD. VICKERS HOUSE BROADWAY LONDON SW1

BRIEFS

figurations and characteristics, bistable jet-configurations in flapper valves, signal transmission in conduits, and use of computers in study of fluid power systems.

Dr. J. Jagan Shearer, associate professor of mechanical engineering, and Dr. Frederick K. Ezekial, assistant professor of mechanical engineering direct the program. Lecturers from industry are Dr. John F. Blackburn, Raytheon Mfg. Co., Waltham, Mass.; Nathan Lockman, Marquardt Corp., Van Nuys, Calif.; Dr. Gerhard Reethof, General Electric Co., Evendale, Ohio; and Clemens Wasynczuk, Chandler-Evans Corp., West Hartford, Conn.

Tuition is $300. No academic credit will be granted. ▼▼▼

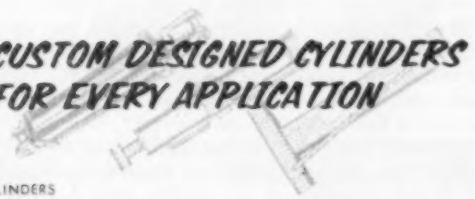
ON THE JOB...

with CROSS HYDRAULIC CYLINDERS

Stay "on the job" with dependable, rugged Cross Hydraulic Cylinders. Like Cross customers everywhere, you too, will appreciate the fast, courteous, dependable service you get from Cross. Phone for speedy delivery on any quantity...quality-built to your specifications. Contact Cross Engineering Department, today!

- RUGGED
- DEPENDABLE
- ECONOMICAL

CUSTOM DESIGNED CYLINDERS FOR EVERY APPLICATION



Try CROSS CYLINDERS in your operation... low cost, dependable, and trouble free.

Lowest-Priced Engineered Quality Cylinders Available..

trade mark of Quality in Hydraulic Cylinders...

HYDRAULIC CROSS CYLINDERS

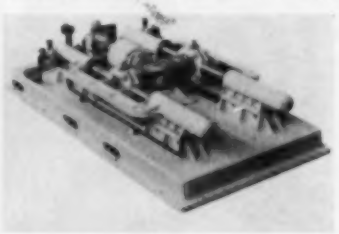
CROSS MANUFACTURING CO.
LEWIS, KANSAS – PHONE EA 4-5525

WRITE • WIRE • PHONE...TODAY!!

Circle 34 on Time-Saver Card

British Firms to Exhibit in New York

The British Exhibition will be held in the New York Coliseum, June 10-26. Among the fluid power manufacturers will be Towler Brothers (Patents) Ltd. The firm will show a new, axial-piston pump. Capacity is 142 gpm at pressures to 5500 psi. This gives it a rating of 500 hp. The Dowty Group will display landing gear of the Avro Vulcan Delta bomber, their hydrostatic transmission, mining equipment, and pit props. Joseph Lucas Ltd. will exhibit hydraulic pumps and motors with variable deliveries to 300 hp.



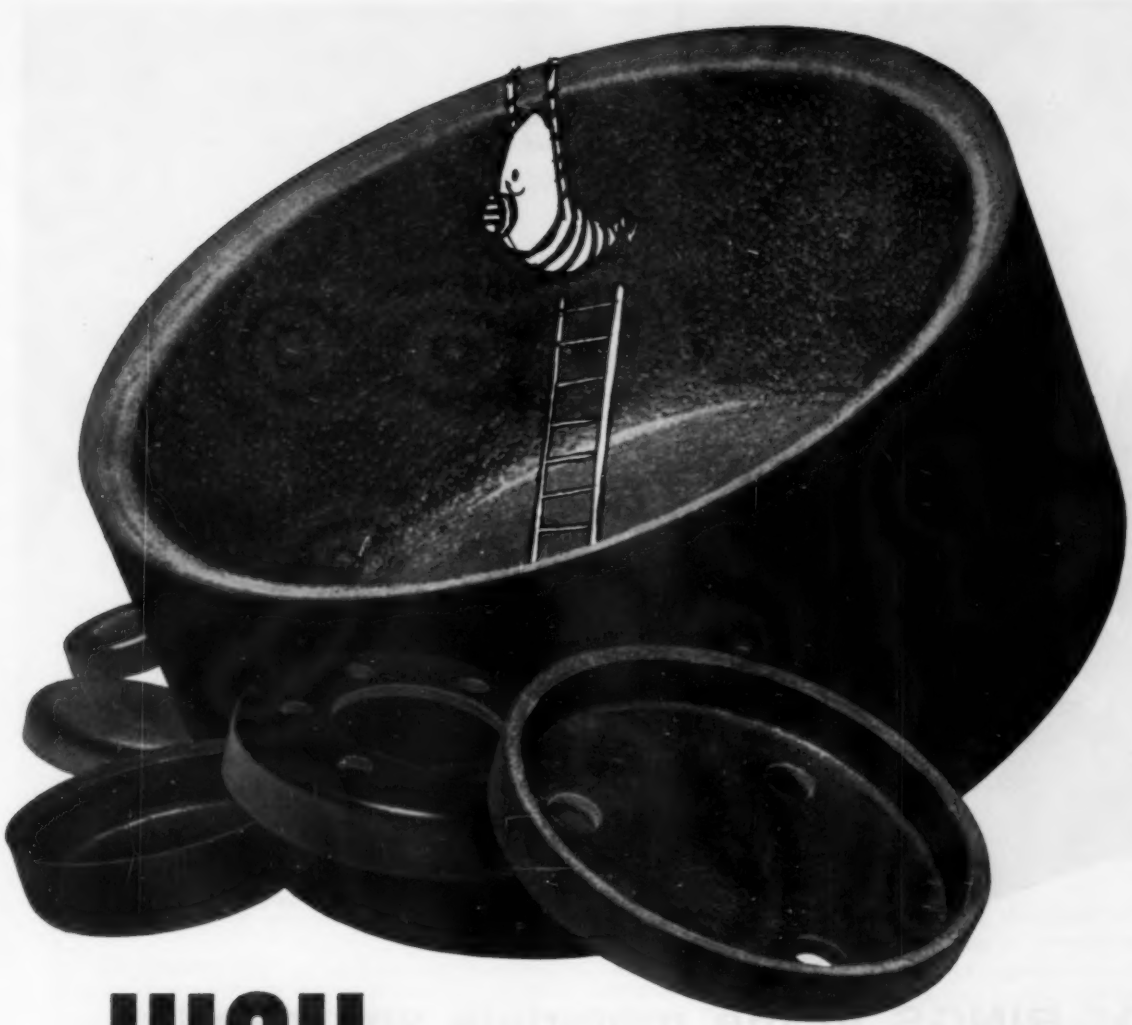
Vickers-Armstrongs (Engineers) Ltd. will show marine steering gear (shown), hydraulic windlass, their variable-speed hydraulic transmission, and hydraulic valves.

Fluid Power Products at Atomic Exposition

The 6th International Atomic Exposition was held recently at the New York Coliseum. It ran in conjunction with the 1960 Nuclear Congress. These exhibited products make interesting use of fluid power.

• **Mobot Remote Mobile Handler**—The remote-controlled manipulator carries out handling

Continued on page 41



HIGH WALLED ?

How long since you have re-evaluated the wall height on your cup packings? Frequently IPC encounters "prints" which call for excessive wall height . . . *and* this extra depth can cause headaches.

Unnecessary wall height can only add to friction and make your cups run "hotter" . . . Torque increases . . . Toe-in is enhanced. Unless there is some unusual factor involved, IPC can recommend a more functional design without these built-in hazards.

Elaborate hide selection combined with IPC "custom treats" and IPC's square shouldered design mean your leather packings and oil seals are started "right". For the finishing touch, IPC offers the last word in quality controlled manufacture.

Let us analyze your leather packings. Perhaps we can tailor a design that will fit your application perfectly.

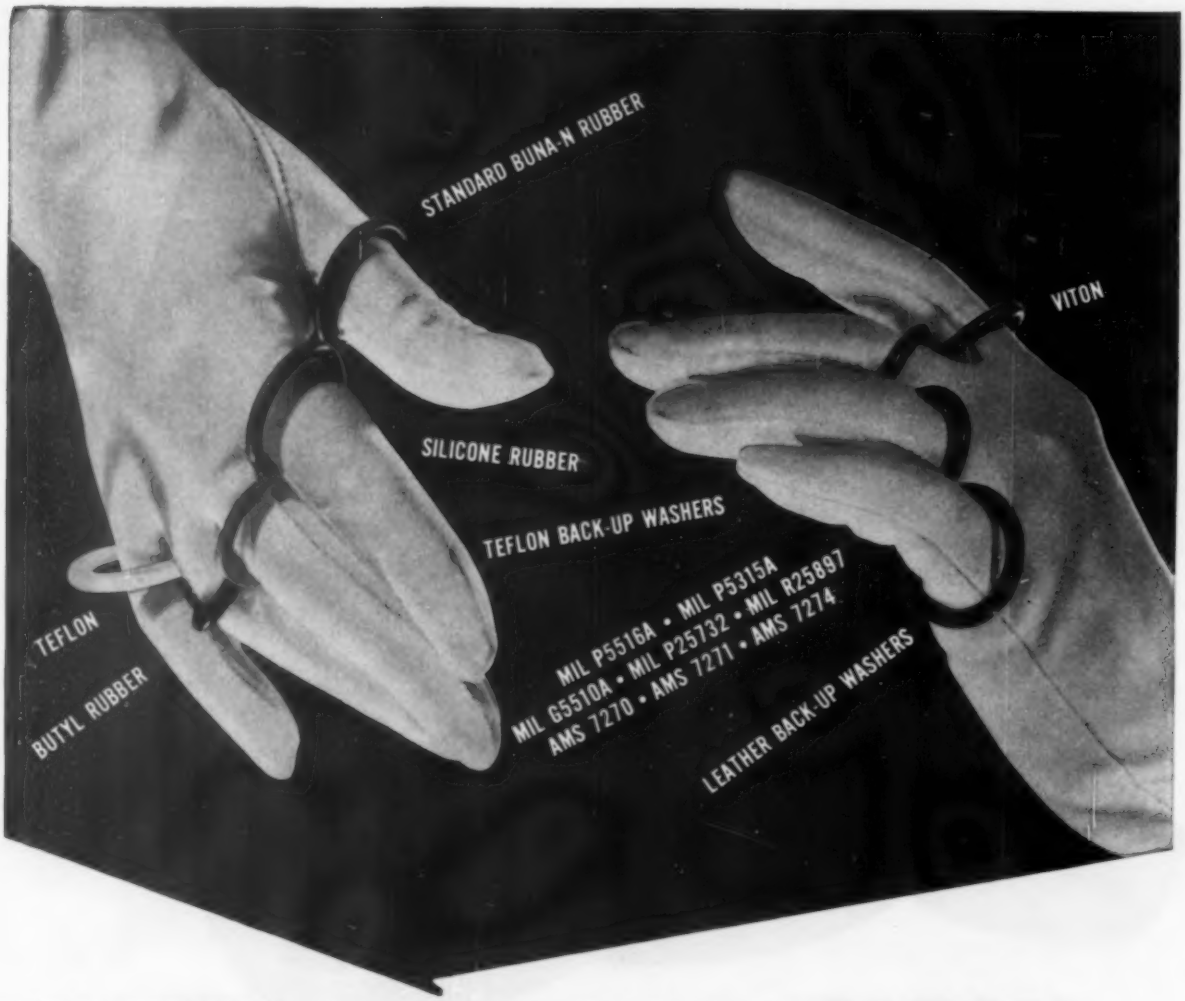
OIL SEALS
PACKINGS
PRECISION MOLDING
Custom designed
. . . for your application

IPC

INTERNATIONAL PACKINGS CORPORATION

Bristol, New Hampshire

P5



"O" RINGS in the materials you need . . . all quantities . . . shipped immediately . . . from Bearings, Inc.

Our stock of "O" Rings is second to none—Not only standard materials in every size but the hard-to-get materials that are usually special orders! Now immediately available for fast delivery from our headquarters in Cleveland, Ohio.

Want complete information on all types of "O" Rings ready for shipment? Call or wire one of our branches or 3634 Euclid Avenue, Cleveland 15, Ohio, NOW!

- 180 "O" Rings in Each Kit—Sizes 1 to 25.
- Patented Plastic Case Shows You "O" Ring Sizes in Kit at a Glance!
- Interchange Data of All Leading "O" Ring Producers in Each Kit — All Manufacturers' Numbers Converted to Universal Numbers.
- Buy Replacement Back-up Washers in these "O" Ring Sizes.

Priced from $24.50 (Depending on Material).

All O-Rings Available in Series 6227, 6230, 6290 and 29513.

Providing bearing service in the North ➤ **BEARINGS, INC.**

OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Lockland • Mansfield • Painesville • Toledo • Youngstown Zanesville • **INDIANA:** Ft. Wayne • Indianapolis • Muncie • Terre Haute • **PENNSYLVANIA:** Erie • Johnstown • Philadelphia • Pittsburgh • York **WEST VIRGINIA:** Charleston • Huntington • Parkersburg • Wheeling • **NEW JERSEY:** Camden • Newark **NEW YORK:** Belanval Corp., Buffalo • Niagara Falls • **MARYLAND:** Baltimore • **DELAWARE:** Wilmington

and in the South ➤ **DIXIE BEARINGS, INC.**

FLORIDA: Jacksonville • **GEORGIA:** Atlanta • **KENTUCKY:** Louisville • **LOUISIANA:** Baton Rouge • New Orleans **N. CAROLINA:** Charlotte • Greensboro • **S. CAROLINA:** Greenville • **TENNESSEE:** Chattanooga • Kingsport • Knoxville • Nashville **VIRGINIA:** Norfolk • Richmond

BRIEFS

operations in contaminated areas. The three-wheeled vehicle has a pair of arms which can perform a great variety of motions, including shoulder rotation, transverse shoulder movement, and elbow movements. It can use such power tools as drills, wrenches, screwdrivers, saws, and welding and cutting torches.

The operator sits at remote console. He watches a pair of closed-circuit TV screens, which give him a depth picture. He steers the vehicle with a lever, controls its speed with a pedal, and uses pistol grip controls for the arms. An electrohydraulic system actuates the arm movements. The tightness of the smooth hydraulic system enables it to handle extremely heavy objects. It locks in any position.

Manufacturer: Hughes Aircraft

Continued on page 42

BRIEF NOTES

TEFLON TASK FORCE . . . for product development has been established by Tri-Point Plastics, Inc., Albertson, N. Y. The group will provide technical assistance in the electronics, missile, and instrument fields. Tri-Point products include O-rings and seals.

PRESSURE DIAPHRAGMS & CAPSULES . . . will be produced by a new firm, Pressure Elements, Inc., East Orange, N. J. The products are for pressure transducers and switches. Operating ranges are from 0-0.1 psid to 0-400 psid. Charles H. Colvin is president of the firm.

NEW PROCESS BUILDING . . . has been completed for Union Carbide's Silicones Div. The Long Reach, W. Va., plant houses batch and continuous processes, high-pressure experimentation, reactions and distallation. The firm has transferred process development activities from Tonawanda, N. Y., to the new plant. C. W. Rehm is superintendent of production.

1000 SQUARE FEET . . . of floor space have been reserved by Dowty Group Ltd., Cheltenham, England, for the British Exhibition, June 10-26, in the New York Coliseum. Dowty will feature products for the aircraft, mining, railway, and power transmission fields.

BENDIX AVIATION CORP. CHANGES NAME . . . to The Bendix Corporation. President Malcolm P. Ferguson explained that the activities of the firm are not limited to the aviation field. Bendix also makes automotive, electronic, nuclear, missile and space, marine, machine tool and industrial products.

BUSINESS BRIEFS

PALL REPORTS 46% EARNINGS INCREASE . . . Pall Corp., Glen Cove, N. Y., netted $162,800, or 37c per share, for the six months ended January 31. Net sales were $2,848,742. Corresponding figures for 1959 were $1,948,555 in sales, and $111,636 earnings, for 25½c per share. The maker of porous stainless steel filters is in its sixth consecutive year of growth.

AIRCRAFT, MISSILE & GSE COMPANY FORMED . . . for R&D and manufacture of control equipment, regulators, turbine flow meters, and pumps. President of Dyna-Matics Corp., Sun Valley, Calif., is J. H. Olverholser. He was sales and engineering vice-president and director of Poly Industries, Inc. E. H. Haag, executive vice-president, was a partner in an aircraft and missiles firm, Air Products Co.

BORG-WARNER CORP. SALES, PROFITS UP . . . For the first three months of 1960, the firm reported sales of $162,022,000. This is an 8.2% increase over the 1959 figure. First-quarter net income was up 7.1%, to $8,319,000.

HIGH PRESSURE IS
AVAILABLE

Dynex supplies complete circuits from 1 to 90 hp in pressure ranges to 6000 psi. A comprehensive design and application engineering service is available to help you apply standard Dynex pumps, motors, valves and cylinders or create special components tailored to your specific circuit requirements for OEM applications. Investigate the many advantages of high pressure hydraulic circuitry. It is available from Dynex . . . now. Ask for bulletin DG-3 which summarizes standard products available.

dynex INC.
A DEVELOPMENT OF BLACKHAWK
IS HIGH PRESSURE
777 DYNEX DRIVE • PEWAUKEE, WISCONSIN
HYDRAULIC PUMPS • VALVES • MOTORS • CYLINDERS • CIRCUITS

Circle 39 on Time-Saver Card

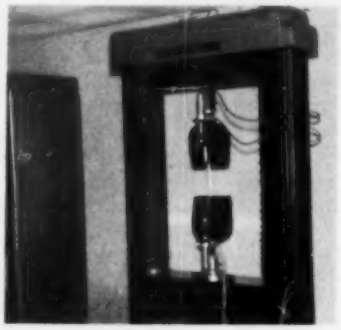
BRIEFS

Co., Nuclear Electronics Laboratory, Los Angeles.

• **Instron Remote Universal Testing Machine**—It tests the tensile strength of materials which have been exposed to radiation. Its jaws are remote-controlled. The read-out dials and recording chart are on the control panel.

Calibration of the load cell requires 100 lb of weights. Most hot-cell manipulators can't handle 100 lb—smaller weights must be accumulated, or personnel must go into the cell for the calibration procedure.

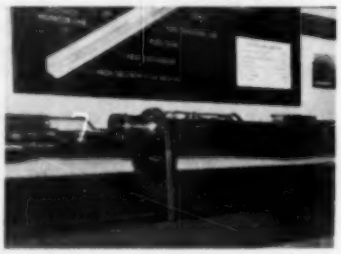
This unit, however, has a built-in 100-lb weight. It is attached to the fixed crosshead. Remote pneumatic controls can apply the crosshead to the load cell. Air cylinders open and close the grips which hold the irradiated specimen. A



hand switch on the solenoid controls the solenoid valves which control the cylinders.

• **In-Pile Loop**—This experimental device uses a hydraulic-motor-driven pump to test fuel and container materials for high-temperature, molten-salt-fueled reactors. Fuels being tested include mixtures of the fluorides of uranium, lithium, thorium, and beryllium.

Hermetic bulkheads divide the loop's three sections. The melted salts are pumped into a loop circuit in the nose section, which is

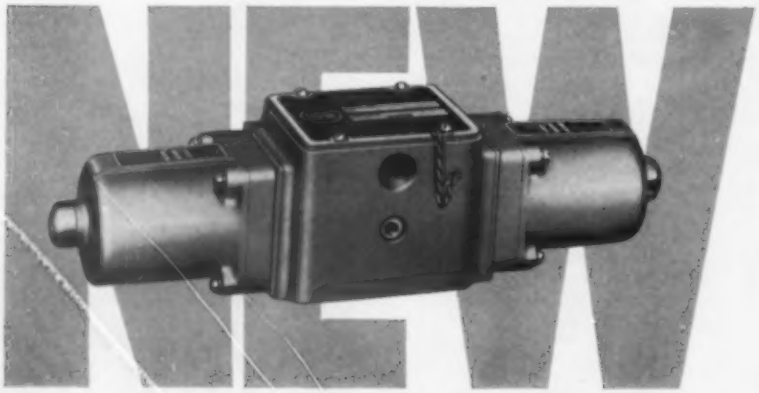


inserted into a reactor for exposure to neutron flux. The intermediate section contains the pump-bearing housing, the hydraulic motor, and conduits and junction boxes. The rear section is a concrete-filled shielding plug, through which pass the service lines to the loop.

External equipment includes the control panel and the hydraulic power unit.

This project is operated for AEC by Union Carbide Nuclear Co., Oak Ridge National Laboratory, Tenn. ▼▼▼

Continued on page 44



H-P-M ¼" four-way pilot valves, single or double solenoid

The new H-P-M ¼" pilot valve is interchangeable with industry standards, handles 9 gpm at 3000 psi, single or double solenoid types available. These are quality valves for long, heavy-duty service at a price comparable with ordinary solenoids. Subplates available for standard mountings.

H-P-M pilot valves feature totally sealed, oil-immersed solenoids for long life and maintenance free operation — virtually millions of extra cycles. Immersed in oil, the solenoid operates cooler, shock and pounding is lessened, normal problems experienced with air gap type solenoids are eliminated. Oil-immersed solenoids have bayonet type connections; service is simplified with no wire connections to break.

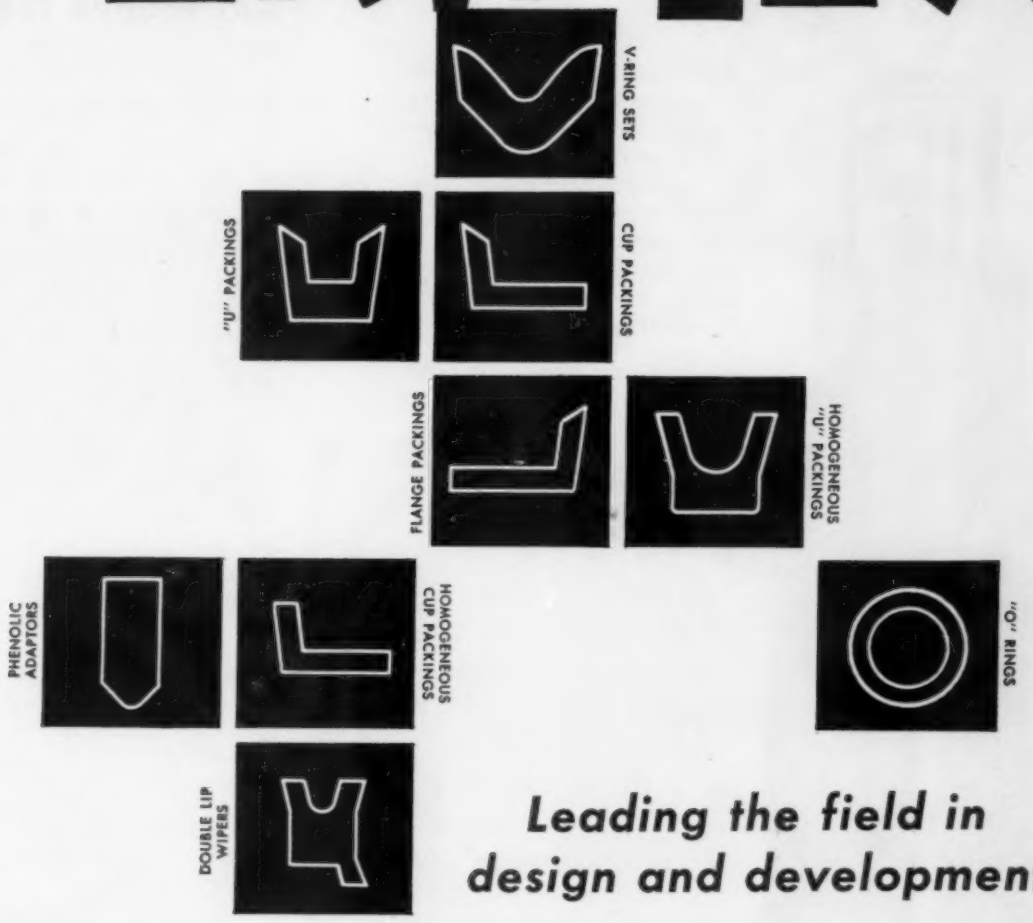
AVAILABLE FROM STOCK FOR IMMEDIATE DELIVERY.
Send for new specification sheets, today.

H54

THE HYDRAULIC PRESS MFG. COMPANY
A Division of Koehring Company, Mount Gilead, Ohio, U.S.A.

Circle **65** on Time-Saver Card

PERiFLEX



Leading the field in design and development

Molded Hydraulic & Pneumatic Packings

If you haven't investigated Periflex, you should—
Periflex offers advanced designs, materials, and know-how. When designing new equipment or re-engineering existing equipment for better functioning, why not consult specialists in reciprocating seals and molded components.

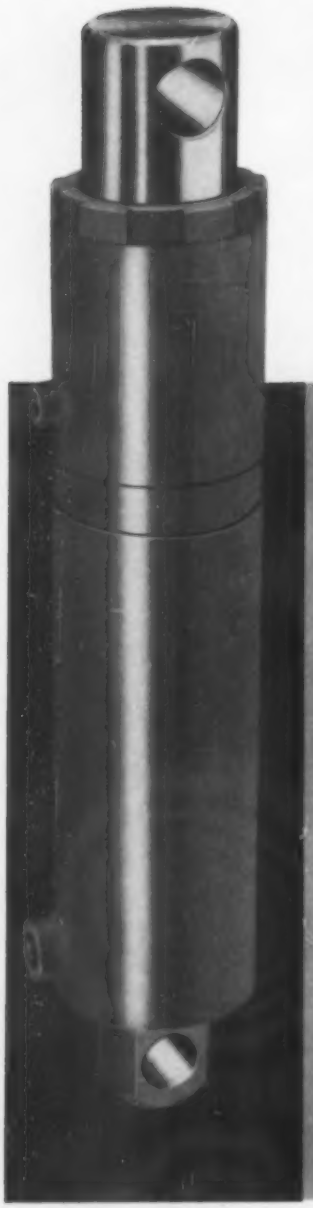
HOMOGENEOUS SYNTHETIC RUBBERS | FABRIC REINFORCED PHENOLICS | SYNTHETIC COATED FIBRES | SYNTHETIC-RUBBER IMPREGNATED FABRICS | NATURAL RUBBER

Periflex • Inc.
HAZEL PARK
MICHIGAN

Circle **106** on Time-Saver Card

CYLINDERS ARE OUR

business!



BHEW precision hydraulic cylinders are designed for your job application. BHEW offers the latest developments, designs and manufacturing techniques. You pay only for what you buy and there are no extra or added expenditures. Trained specialists analyze your specific application. BHEW products are available at production prices and are precision-manufactured to produce the highest level of performance.

FOR BETTER ON-THE-JOB RESULTS, INSIST ON B-H-E-W PRODUCTS!

BHEW Single-Acting General Purpose Cylinders (1500 psi Displacement—Ram Style Series) are designed around standard components but custom-built to your application. They're available in a variety of mountings (pin eye is standard) with or without adjustable or non-adjustable rod ends.

DISCUSS YOUR DESIGN AND APPLICATION PROBLEMS WITH US!

WRITE TODAY for free Hydraulic Cylinder Engineering Reference data. 78 dimensional basic designs for general purpose and special double- and single-acting cylinders. SAVE TIME!

BH EW

- Basic Designs
- Specific Adaptations
- Superior Quality
- Application Engineering

BENTON HARBOR ENGINEERING WORKS, INC.

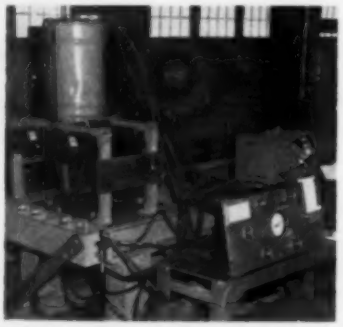
622 Langley Avenue • St. Joseph, Michigan

Circle **24** on Time-Saver Card

BRIEFS

Accumulators Aid Fatigue Test

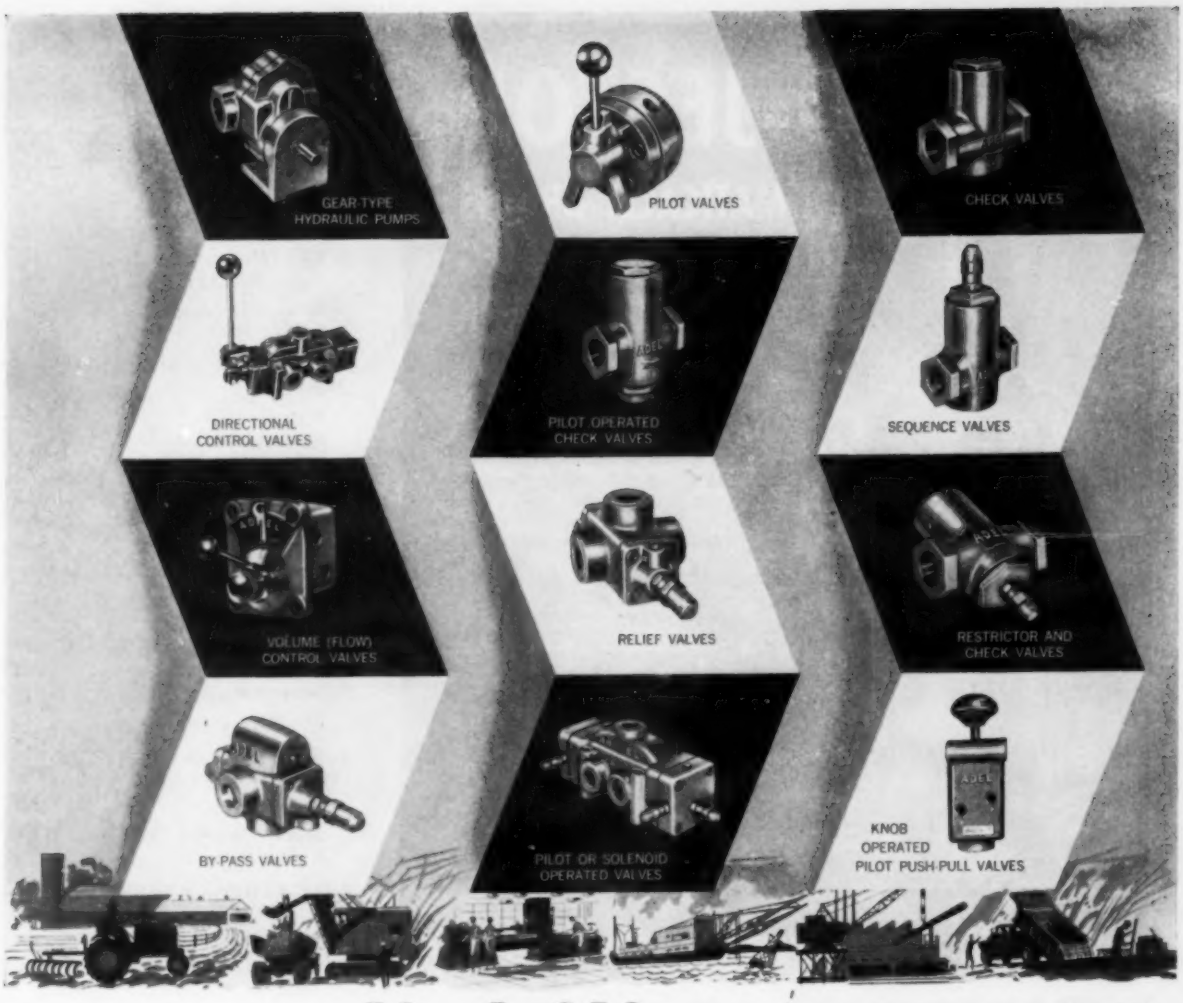
Hydraulic accumulators are necessary on a fatigue-test rig at Kaman Aircraft Corp., Bloomfield, Conn. Parts tested are main-rotor pitch springs and hinges for the HU2K-1 helicopter. Superimposed



vibratory loads change the length of the test pieces. The rig operates at 1000 psi. The oil temperature gets up to 150 F. Oil is pumped to a double-acting cylinder connected to the test piece. The industrial, piston-type accumulators take pulsation out of the cycle and maintain a steady axial load, despite the length changes.

The test program went beyond 15 million cycles with no seals having to be replaced. Not a minute was lost. ▼▼▼

HYDRAULIC ROTATING CLAMPS handle eight 11.00 x 20, 20-ply truck tires without pallets, skid platforms, containers, or bands. Opposed 65" x 10½" steel pads hold them. The device picks up tires placed side-by-side or stacked. It reverses their position for storage. Clamp separation ranges from 24" to 48". Capacity of the clamps is 1800 lb. It fits Yale & Towne lift trucks to 3000 lb. capacity.



reliability / ADEL PRECISION HYDRAULIC EQUIPMENT

....synonymous for fail-safe performance!

A complete line of valves and pumps for every application ADEL contributes cost-savings to the Original Equipment Manufacturers, not only in terms of initial cost, but in design features that provide preventive maintenance and, most important, *maximum operating efficiency over the years.* ■ If you need a hydraulic valve or pump replacement for your equipment...*specify* ADEL and you won't need another! ■ **You name the application...** ADEL has the Precision Hydraulic Equipment to meet your requirements. ■ *Write for complete engineering specifications.*

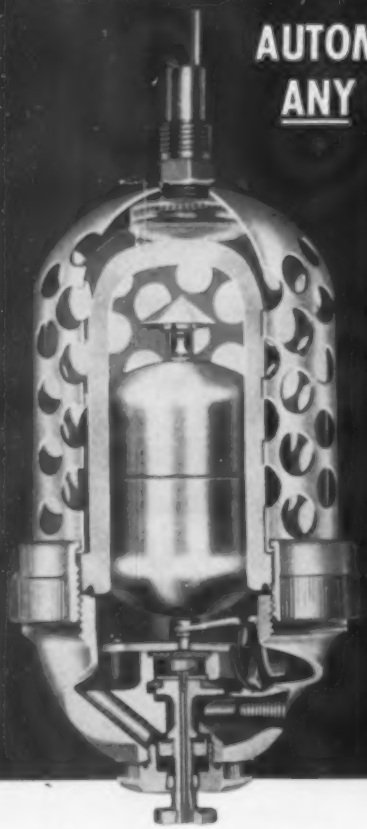
NEW DIMENSIONS IN reliability **ADEL** PRECISION PRODUCTS

Designers and Manufacturers of
INDUSTRIAL & MARINE
HYDRAULIC CONTROL EQUIPMENT

A DIVISION OF GENERAL METALS CORPORATION
1444 WASHINGTON AVENUE,
HUNTINGTON 4, WEST VIRGINIA
DISTRIBUTORS IN PRINCIPAL CITIES THROUGHOUT THE U. S. AND CANADA

HYDRO-JECTOR

AUTOMATICALLY DRAINS ANY FILTER, DRAIN LEG OR SURGE TANK



- GUARANTEED minimum 1 year trouble-free operation
- ½ internal discharge port
- Connecting Nipple available in 3 sizes
- Discharges at rate greater than 300 gallons of water per hour at 125 PSI
- Drains oil as well as water
- Transparent *Visi-Bowl* permits visual inspection
- Operates on pulsating, continuous or no flow
- No air loss during dump cycle
- Vent Nipple prevents air lock
- Manual Plunger permits "clean-out" without disassembly

The *M/P Hydro-Jector* can be installed easily and quickly in the bottom drain port of *any* compressed air filter, separator, drain leg, water bottle, surge tank, air receiver tank or other water collecting vessel.

This is not an ordinary float operated trap. The *Hydro-Jector* incorporates unique pilot valving and large internal discharge passages.

Only M/P offers a one year guarantee against clogging.

WRITE TODAY FOR COMPLETE INFORMATION

NEW AIR CYLINDER LUBRICATOR

For application in the *M/P Down-Stream Circuit*—a new M/P concept which assures reliable lubrication of even the smallest air cylinders.

SHATTER-GUARD

A new feature which makes the *M/P Visi-Bowl* as safe as a metal bowl. Available on all M/P Filters, Lubricators and Hydro-Jectors.

MASTER PNEUMATIC, INC.

20430 SHERWOOD • DETROIT 34, MICHIGAN • Phone: TWinbrook 3-7070

Circle **87** on Time-Saver Card

FUTURE EVENTS

MACHINE TOOL EXPOSITION & MEETING
September 6-16
International Amphitheatre
Chicago, Illinois

PRODUCTION ENGINEERING SHOW
September 6-16
Navy Pier
Chicago, Illinois

ASME JOINT AUTOMATIC CONTROL CONFERENCE
September 7-9
Massachusetts Institute of Technology
Cambridge, Mass.

2ND COLISEUM MACHINERY SHOW
September 7-15
Chicago Coliseum

ASME-AIEE POWER CONFERENCE
September 21-23
Bellevue-Stratford Hotel
Philadelphia, Pa.

ASME RUBBER & PLASTICS CONFERENCE
October 9-12
Lawrence Hotel
Erie, Pa.

ASME-ASLE LUBRICATION CONFERENCE
October 17-19
Statler Hilton Hotel
Boston, Mass.

16TH NATIONAL CONFERENCE ON INDUSTRIAL HYDRAULICS
October 20-21
Sherman Hotel
Chicago, Illinois
For additional information, contact Leroy A. Wickstrom, Illinois Institute of Technology, Chicago 16, Illinois

NATIONAL FLUID POWER ASSOCIATION FALL MEETING
October 31-November 2
Edgewater Beach Hotel
Chicago, Illinois

1ST NATIONAL DIE CASTING EXPOSITION & CONGRESS
November 8-11
Detroit Artillery Armory

ASTME WESTERN TOOL SHOW
November 14-18
Los Angeles Memorial Sports Arena

With Extras . . . At No Extra Cost

1. METAL PISTON ROD SCRAPER—protects rod packing, cylinder bore and rod surface by removing all foreign particles.
2. NEW "SUPER" CUSHION for air or METALLIC SELF-ALIGNING MASTER CUSHION for oil.
3. HARD CHROME PLATED CYLINDER BORES AND PISTON RODS for greater protection and reduced wear.
4. ONE PIECE PISTON assures better alignment, longer bearing and packing life.
5. FORGED SOLID STEEL HEADS throughout entire line.
6. PILOTED PACKING GLAND with extra long bearing for additional strength and support to piston rod.
7. NO TIE-RODS TO STRETCH—gives you 360° port rotation . . . less space used . . . full strength.
8. STREAMLINED DESIGN . . . operating pressures to 200 PSI, air; 1,000 PSI oil, non-shock.

Specify the

T-J Spacemaker

for longer, more efficient cylinder service

You too—can reduce replacement expenditures—lower maintenance costs with the T-J Spacemaker cylinder line. Designed and engineered for ruggedness, and accuracy of operation, the Spacemaker assures longer, uninterrupted operation.

The T-J Spacemaker eliminates tie-rods, gives greater strength, saves space . . . and reduces costs in all push-pull operations. Immediate delivery in a complete range of styles and capacities . . . air or oil. Write for Bulletin SM 155-4, today. The Tomkins-Johnson Company, Jackson, Michigan.

T-J TOMKINS-JOHNSON

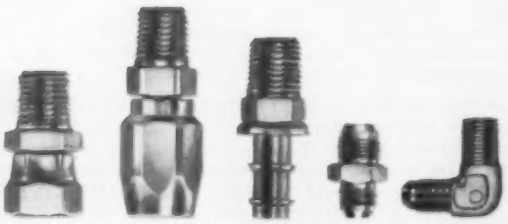
RIVITORS . . . AIR AND HYDRAULIC CYLINDERS . . . CUTTERS . . . CLINCHORS

NOW FROM STEWART-WARNER...

New SURGEPRUF® couplings and hose

Now from one reliable source, you can obtain hose assemblies for all types of applications, ranging from fuel lines to high-pressure hydraulic lines—and with the assurance that you are getting only finest quality supplies, manufactured by Stewart-Warner. Available in complete assemblies for immediate use. Nationally distributed. See your supplier, or mail coupon for new Surgepruf catalogs.

A Full Reusable Coupling Line... Assembled to Surgepruf Non-Skive and SAE 100RI, 100R2 and 100R5 Hydraulic Hose...Without Special Tools!



Reusable Couplings and Adapters are available in a full range of thread styles and sizes for all types of hydraulic connections.

Only Surgepruf Reusable Couplings and Hose Have These Outstanding Features:

Superior Fluid Seal, with no wire braid exposure, eliminates seepage between coupling shell and wire braid.

Non-Skive Assembly provides fastest field assembly with just ordinary tools.

Superior Finish—Precision-machined steel couplings have zinc dichromate finish . . . meet rigid salt-spray testing requirements.

Full Interchangeability—regardless of hose line—Surgepruf couplings are available in any style and thread.

High Pressure Hose and Reusable Couplings. Reinforced with high tensile, two wire braid. Synthetic rubber outer cover for top resistance to hydraulic fluid, weather aging and abrasion. Available in non-skive and SAE 100R2 construction. Burst and working pressure equivalent to SAE 100R2. Available in hose ID's from ¼" to 2".

Medium High Pressure Hose and Reusable Couplings. Reinforced with high tensile single wire braid. Available in non-skive and 100R1 synthetic rubber cover, or SAE 100R5 cotton cover. Burst and working pressure equivalent to SAE 100R1 or 100R5, available in hose ID's from ¼" to 1½".

Medium Pressure Swaged-on Hose Assemblies. Neoprene rubber-covered fabric braid hose complies with SAE 100R3 requirements. Available in hose ID's from ¼" to 1". These assemblies are made only with factory-applied steel swaged-on couplings.

Assemblies also available in one and two wire braid hydraulic hose.

Low Pressure Hose and Reusable Couplings. Reinforced with a single fabric braid. Burst pressure, 1000 psi; working pressure, 250 psi. Available in hose ID's from ¼" to ¾".

NATIONAL HOSE ASSEMBLIES AND FITTINGS NHAFMA MANUFACTURERS ASSOCIATION

Symbol of SW Excellence

ALEMITE DIVISION
STEWART-WARNER CORPORATION

1850 Diversey Parkway, Chicago 14, Illinois

Stewart-Warner Corporation, Surgepruf Div.
1850 Diversey Parkway, Chicago 14, Illinois

Please send me your new complete Surgepruf catalogs.

Name .....

Address .....

City ..... Zone ..... State .....

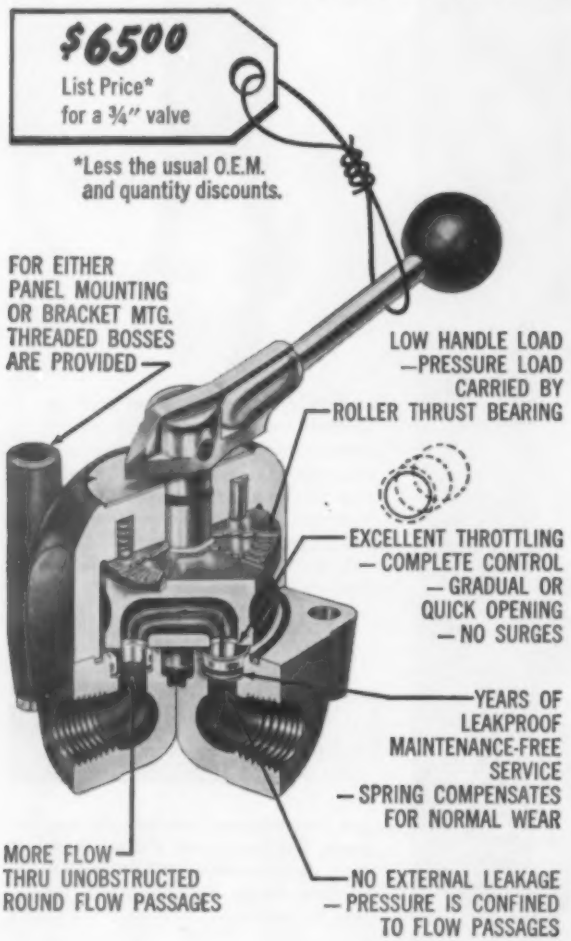
Circle 6 on Time-Saver Card

NEW!

A "SHEAR-SEAL" VALVE

for LESS than a spool valve

RATED FOR 3000 P.S.I. OIL SYSTEMS


$65.00
List Price*
for a ¾" valve
*Less the usual O.E.M. and quantity discounts.
FOR EITHER PANEL MOUNTING OR BRACKET MTG. THREADED BOSSES ARE PROVIDED
LOW HANDLE LOAD —PRESSURE LOAD CARRIED BY ROLLER THRUST BEARING
EXCELLENT THROTTLING — COMPLETE CONTROL — GRADUAL OR QUICK OPENING — NO SURGES
YEARS OF LEAKPROOF MAINTENANCE-FREE SERVICE — SPRING COMPENSATES FOR NORMAL WEAR
MORE FLOW THRU UNOBSTRUCTED ROUND FLOW PASSAGES
NO EXTERNAL LEAKAGE — PRESSURE IS CONFINED TO FLOW PASSAGES

For complete data on this new valve and for information on all your valve requirements write for Catalog V-59-60

CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle 18 on Time-Saver Card

NEW PISTON PRESSURE SWITCH

CONTROLS 2 INDEPENDENT ELECTRICAL CIRCUITS

Really TWO pressure switches for the price of ONE

7000 P.S.I. PROOF

*With calibrated dials (both settings can be made visually without gauges). Without dials $29.50. Both prices subject to the usual quantity and trade discounts.

WE BUILD IN	WE DON'T USE
RUGGEDNESS CAN TAKE SURGES (High proof pressures) CONTINUOUS OPERATION (Millions of cycles) NO STICKING (in dirty fluid)	LINKAGES & BEARINGS WHICH WEAR QUICKLY (cause settings to drift and switch to fail).
LABOR & MATERIAL SAVINGS NO RETURN DRAIN PIPING (Sealed piston) MOUNTS WHERE CONVENIENT (Operates in any position, not sensitive to vibration)	UNSEALED PISTONS WHICH ADD TO YOUR INSTALLATION COST (return piping). ARE CRITICAL TO DIRT (pistons get stuck).

Send for FREE catalog 9-PS.

PRESSURE SWITCH DIVISION

Barksdale valves

5125 Alcoa Avenue, Los Angeles 58, California

Circle 19 on Time-Saver Card

Hydraulic Power System Ideas . . . from **SUNDSTRAND**

Sundstrand test combine powered by new closed-circuit hydrostatic propulsion system. Drive has also been applied to industrial mobile equipment.

START . . . STOP . . . REVERSE . . . Change speed with a single lever

The Sundstrand hydrostatic transmission offers many operational advantages to the heavy machinery manufacturer and user, including single lever control for speed and direction, infinitely variable speed range, dynamic braking, and constant propelling speed regardless of load (torque varies automatically). Application possibilities for this versatile system are almost endless.

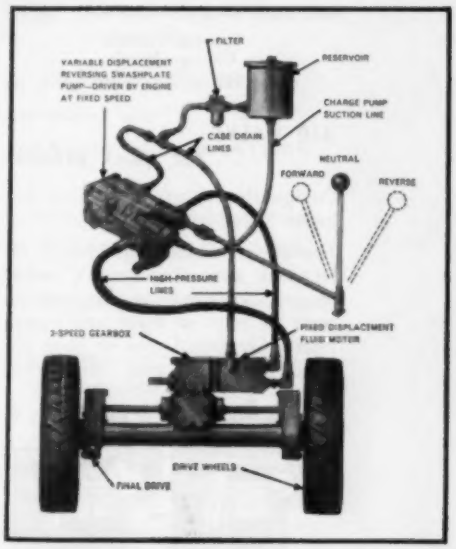
THE SYSTEM is comprised of a reversing swashplate, variable displacement pump, a fixed displacement motor, and an oil reservoir. On the farm combine shown above the pump is driven by the combine engine and requires no separate power source. The fixed displacement motor drives through a three-speed gearbox (emergency, working, transport) to differential and wheels.

HOW IT WORKS. The function of the variable displacement pump is to convert the constant output speed of the combine engine to infinitely variable power at the wheels. This is accomplished by the reversing swashplate in the pump. The position of the plate determines the quantity and direction of oil going to the fixed displacement motor. The swashplate is controlled by a single lever beside the operator.

Once control lever is set for a certain drive speed, the hydrostatic transmission will maintain that speed regardless of load. On the combine this assures ground speed matched to thresher load . . . permitting the operator to devote more time to other operations.

LEVER CONTROLS BRAKING. To slow or stop the wheels, the operator simply moves the control lever toward neutral. Reduction in driving angle of swashplate retards oil flow to fixed displacement motor, slowing the wheels. Dynamic braking helps simplify equipment design by eliminating all other braking systems except those needed for parking.

The new Sundstrand hydrostatic propulsion system described can be applied to a wide variety of equipment now using mechanical transmission systems. For quantity installations the system also compares favorably with mechanical systems on a unit cost basis.



If you would like more information about the many application possibilities of Sundstrand hydraulic components and systems, write outlining your requirements to:

Mr. Ray Murphy, *Application Engineer*

SUNDSTRAND HYDRAULICS
DIVISION OF SUNDSTRAND CORPORATION
2210 Harrison Avenue • Rockford, Illinois

Circle **126** on Time-Saver Card

NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

SINGLE-ACTING CYLINDER
. . . has ¾" stroke

Designation: Model BL-1

Features: For clamping, work feeding, or ejection. Ram pad suits cylinder to uneven surfaces.

Specifications: For 150-psi air, 500-psi oil or water. 1" bore. ¾" stroke.

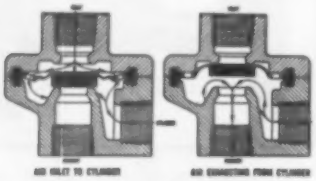
½" ram is drilled and threaded with 5/16"-18 internal thread. Allows insertion of hardened face pad or 15-deg. swivel pad. Ram end has 7/16-diameter wrench flats. Swivel or face pad has ½" adjustable length.

Superior Controls
Chicago, Illinois
Circle **300** on Time-Saver Card

AIR VALVE
. . . for quick exhaust

Designation: Pneu-Trol Quick Exhaust Valve

Features: Air moving through inlet port seats diaphragm's center section, closes exhaust port, and unseats 12 holes on diaphragm's periphery. Combined area of holes exceeds inlet port area. Air moves



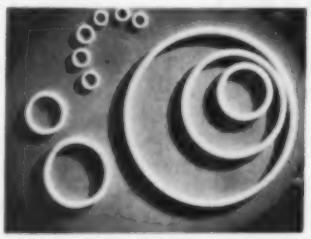
to cylinder. In exhaust cycle, cylinder return pressure builds up over entire diaphragm area. Pressure closes inlet holes, snaps center seating section off exhaust port. Operates in any position. Eliminates large-diameter piping and large selector valves. Smoother, faster cylinder operation. Wider application of air-powered motions.

Specifications: For ⅜" pipe sizes. Recommended pressures are 125 psi maximum, 5 psi minimum. Aluminum valve body.

Auto-Ponents, Inc.
Bellwood, Illinois
Circle **301** on Time-Saver Card

TEFLON O-RINGS
. . . in new sizes

Features: 300 standard sizes in new SAE ARP-568 uniform dash-numbering system for O-rings. Large selection makes fewer modifications necessary to adapt to standard



equipment. Available in commercial surface, and Mirror-Finish surface (which provides more positive initial seal on O-rings).

Chicago Gasket Co.
Chicago, Illinois
Circle **302** on Time-Saver Card

HYDRAULIC DOUBLE PUMPS
. . . are vane type

Designation: High Performance

Features: One power source for two circuits or greater volume with combined delivery. Replaceable cartridge has all wearing parts, can be installed in 10 minutes. Optional flow control and relief valves can be made integral with small side of most pumps. Inlet rotates in 90-deg. increments. Five models. Four-bolt SAE flange connections.

Specifications: Normal operation at speeds to 2000 rpm, pressures

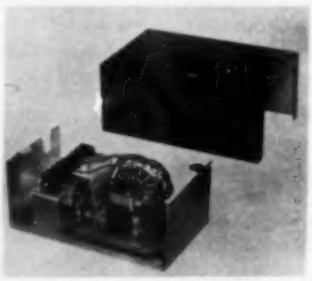
to 2000 psi. Capacities range from 8 gpm in small section to 77 gpm in large section.

Vickers, Inc.
Div. Sperry Rand Corp.
Detroit, Mich.
Circle **303** on Time-Saver Card

SEQUENCE CONTROLLER
. . . switches 2 to 12 circuits in predetermined sequence

Designation: SC-500

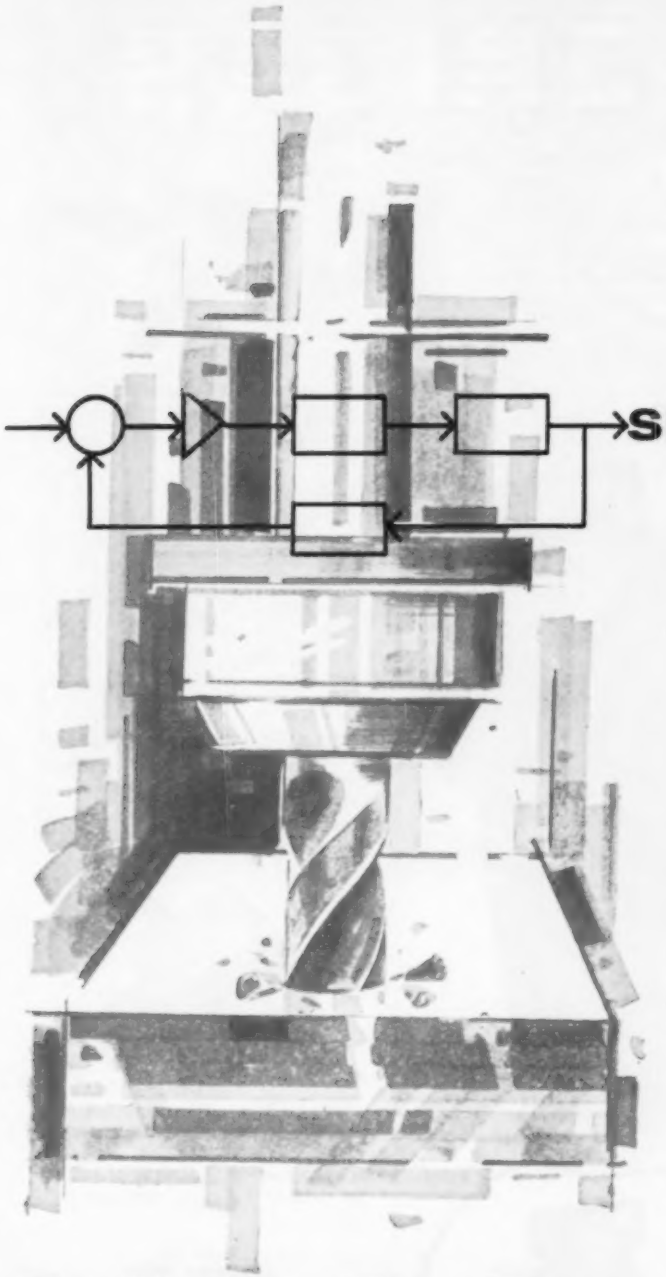
Features: Electrically operated by pulses from limit or foot switches, relays, etc. Sequence repeated as long as pulses continue. Flexibility of sequence arrangement.



Specifications: Normally takes one step in switching sequence per pulse. Available to take two or more steps. Size 3⅛" x 4⅜" x 7¼". Switch contacts are pilot duty, 3 amp, 115 vac.

Warco Industries, Inc.
St. Louis, Mo.
Circle **304** on Time-Saver Card

Continued on page 54



electrohydraulically speaking...

how accurate, how reliable is a SERVOSYSTEM?

The servovalve is the prime determining factor of reliability and accuracy in a Servoactuation system. In a drive control system which includes servovalves, amplifiers, actuators and necessary power supplies, exceptional valve performance is required. Use of Moog's servovalve and unitized approach to system design insures maximum component performance.

SERIES 71 SERVOVALVE

SERIES 73 SERVOVALVE

comparatively speaking . . .

WHAT ADVANTAGES DO ELECTROHYDRAULIC SERVOSYSTEMS OFFER?

". . . First and foremost, they provide dynamic response capabilities completely out of the range of any other types of control . . . Their range of dynamic response is much higher than the fastest pneumatic system . . .
The next important advantage offered is size and weight . . . the complete hydraulic system for all but the very low horsepower applications is lighter than any other type of powered control system . . .
Third, the systems are rugged. They can operate under severe environmental conditons."*

*Bernard A. Johnson NCIH Article 13th Annual Meeting
"The Application of Electro-hydraulic Servo Valves to Industrial Control"

MOOG:

SERVOSYSTEMS IN INDUSTRY

WRITE FOR PB110

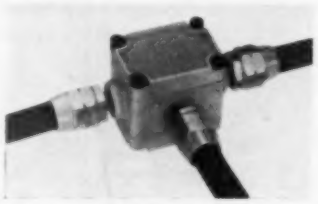
MOOG SERVOCONTROLS, INC. INDUSTRIAL DIVISION EAST AURORA, N. Y.

NEW PRODUCTS

AIR BRAKE SAFETY DEVICES . . . meet ICC regulations

Designations: Hytrol Saftey Valve, Hytrol Aire-Spring chamber.

Features: Safety valve protects against air-pressure loss. Closes off any part of system. System's other brakes can function as usual. Actuation of dual-diaphragm valve depends upon system's final pressure. Operates from 10 psi to maximum compressor pressure. Operates with leakage rates as low as 5 cfm. Vibration, truck, or road condition doesn't affect it. Fits any size air-brake lines for wheel-to-wheel or axle-to-axle protection. Spring chamber is emergency brake. Automatically applies brakes in proportion to air pressure, at pressures starting below 55 psi. Wheel can't move until safe air pressure is regained in system, or until brakes are manually released. Intsalled with any brake chamber V-band coupling. Becomes integral part of brake chamber. Tie rod prevents spring explosion. Full stroke of



brake chamber maintained. All moving parts enclosed. Valve and chamber meet new California law and ICC regulations.

Specifications: Valve weighs 20 oz. Is 2½" x 4" x 2⅜". For —40 to 180 F. When mounted on vehicle, chamber weighs 20 lb per axle.

Hydro-Aire Co.
Div. Crane Co.
Burbank, Calif.

Circle **305** on Time-Saver Card

Capital

HYDRAULIC FILTERS

for Hydraulic and Oil Re-circulating Machinery

Capital Hydraulic Filter Units are smaller than ordinary filters but with filtering capacity equal or superior to many larger filters. Small size permits greater latitude in design, particularly where space is restricted.

Capital Filter Units are designed with one-piece construction — no screws or nuts to work loose and be lost or mislaid. Simple and easy to clean by any method.

Made from specially designed woven Monel wire, with narrow corrugations presenting the greatest filtering area. Monel support supplies extra sturdiness.

Capital Filter Units are made in 4 Types:

- MONO-BILT 60 Mesh All Stainless Steel (Sump type).
- MONO-BILT Standard All Stainless Steel
- MONO-ECONO Mono-Bilt with Monel Metal Insert and Cadmium Plated Top and Bottom.
- LINE TYPE with Aluminum Housing and Mono-Bilt, one Piece Filter Unit.

Capital Line Type Filter

Built from Monel Metal they are impervious to rust and corrosion.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle **26** on Time-Saver Card

VARIABLE-VOLUME PUMPS . . . in four models

Designation: Models 6-500L & 6-500R for 500 psi, 7 gpm; 6-1000L & 6-1000R, 1000 psi, 6.5 gpm.

Features: Use movable cam ring for automatic adjustment of volume to demand. Maintain constant pressure.

DoAll Co.
Des Plaines, Illinois

Circle **306** on Time-Saver Card

HYDRAULIC POWER CHECK . . . cushions cylinders

Designation: Pow-R-Trol

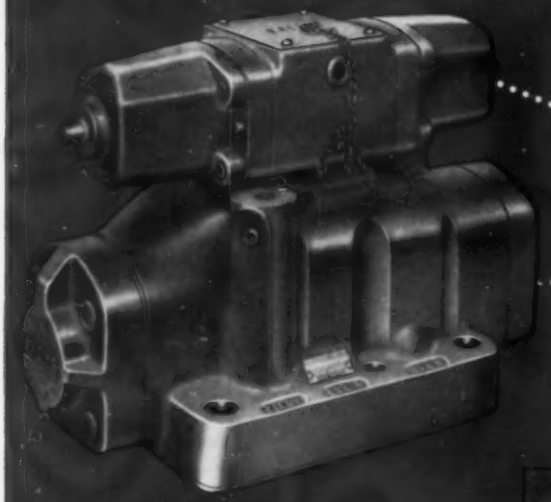
Features: Operating cylinder forces fluid through 1-way valve. Rate of flow governs cushion. Manually adjustable. May be furnished with air or solenoid-actuated pilot valve to provide stop checking or skip

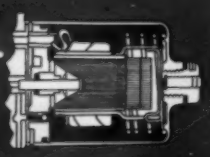
Continued on page 56

RACINE-SECO

VERSATILE

4-WAY HYDRAULIC DIRECTIONAL CONTROLS





FEATURES

- Design conforms to J.I.C. standards
- High flow capacity
- Direct or remote pilot pressure operation
- Throttling end caps for ¾" and 1¼" sizes
- Oil immersed solenoids available
- Sub-plate mountings on all sizes

From a design and operational consideration these RACINE-SECO valves are the finest directional controls made. Compact streamlined design — dust proof construction. RACINE-SECO 4-way valves are available in single solenoid spring return and double solenoid standard action or spring centering.

Sizes ¼", ¾" and 1¼" up to 2000 psi.

Write for RACINE-SECO Catalog No. 59-A describing our complete line of Hydraulic Equipment.

RACINE HYDRAULICS & MACHINERY, INC.
RACINE, WISCONSIN

One Source — One Responsibility for all your hydraulic needs.

jamesbury

"Double-Seal" Ball Valves

STYLE "H" SERIES HIGH PRESSURE

3000 TO 4500 P. S. I.

"Double-Seal" BALL VALVES

- Pressure range: high vacuum to high pressure
- Virtually leakproof and indestructible in service
- Temperature range:—320°F to +400°F*
- Eight sizes ¼" through 2"—available in both pipe and tubing threads
- On-Off service, quarter-time, full flow construction

...a unique, compact, single-piece body of rugged design which permits wide high-pressure, high-vacuum applications, especially recommended for hydraulic equipment and the handling of compressed gases or hazardous fluids. Cryogenic (low temperature) uses are also feasible with extended bonnet adaptation. Available in Straight Tubing or Standard Pipe Thread as catalog items. Flanged valves available on special order.

¼ In. — ½ In.
4500 PSI (—20°F to +160°F)

¾ In. — 2 In.
3000 PSI (—20°F to +160°F)

Jamesbury Style "H" Double-Seal Ball Valves are available in Carbon Steel, 303 and 316 Stainless Steel.

"TEFLON", Special Nylon or synthetic rubber seats and seals.

*Selection of valve seats and seals determine the temperature and pressure ratings.

Write for Materials and Pressure Specification Sheets for Style "H" series for performance data.

JAMESBURY CORP., 72 NEW STREET, WORCESTER, MASS.

364-0

Distributors in Principal Cities

Circle **71** on Time-Saver Card

NEW PRODUCTS

checking. For air, oil, or water cylinders. Stainless steel or aluminum components. O-rings seal end caps. Single-action models provide for-

ward or reverse action. Double-action models available in larger sizes.

Specifications: For strokes to 20", operating pressures to 3000 psi.

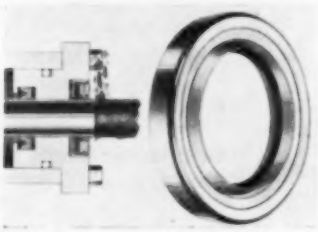
Appco Div.
Pokorny Industrial Products Co.
Cleveland, Ohio

Circle **307** on Time-Saver Card

WIPER & SCRAPER RINGS . . . for rods from ½" to 6"

Designation: SC Wiper Scraper Seal

Features: Thin brass (other material available) scraper ring and synthetic rubber wiping member



clamped into steel shell. Scraper ring OD has enough play for off-center rods. Scraper ID slightly under rod size. No special machining for grooves or retaining rings in steel cylinders.

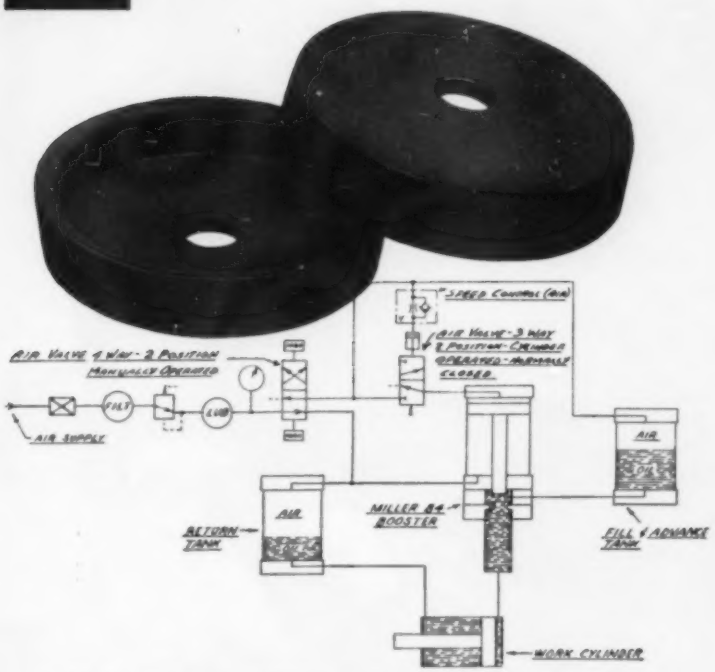
Chicago Rawhide Mfg. Co.
Chicago, Illinois

Circle **308** on Time-Saver Card

For more NEW PRODUCT reviews turn to page 126

MECHANICAL LEATHERS

in Design Engineering



Garlock leather packings are formed with minimum radius at heel to assure longer service life against cold and hot water, oils, air or fire-safe phosphate ester fluids.

Under many service conditions leather packings do a much better job than other materials in preventing leakage of hydraulic and pneumatic media.

Low Coefficient of Friction—Leather materials retain lubricants, create less than half the friction of other common packing materials. Lower friction means smooth easy movement and long service life.

High Tensile Strength—Leather packings will withstand the highest operating pressures and shock loads because of their interwoven natural fiber structure. Average strength measures 3000 PSI.

Lower Cost—Based on longer service life and fewer overhaul or repacking jobs, leather packings save you in reduced downtime and maintenance labor.

Will Not Score or Abrade—In rough unfinished cylinders, leather will polish metal surfaces which they contact, will not abrade under conditions which would destroy other packing materials.

Long Storage Life—Leather will not deteriorate due to oxidation or sunlight. They can be kept in stock indefinitely without loss of essential qualities.

In any of three leathers—BITAN*, Chrome, or Oak—Garlock can furnish all shapes, sizes, and designs of leather packings for hydraulic use. They're made in a modern packing plant which maintains highest standards of quality. Molded Cups, "U" Packings, "V" Packings, Washers, Gaskets, Discs, Flange or Hat Packings are some of the more commonly specified types. Sizes range from 1/8" O.D. leather washers for needle valves to 99" O.D. "U" Packings . . . rubber, plastic or wax impregnations.

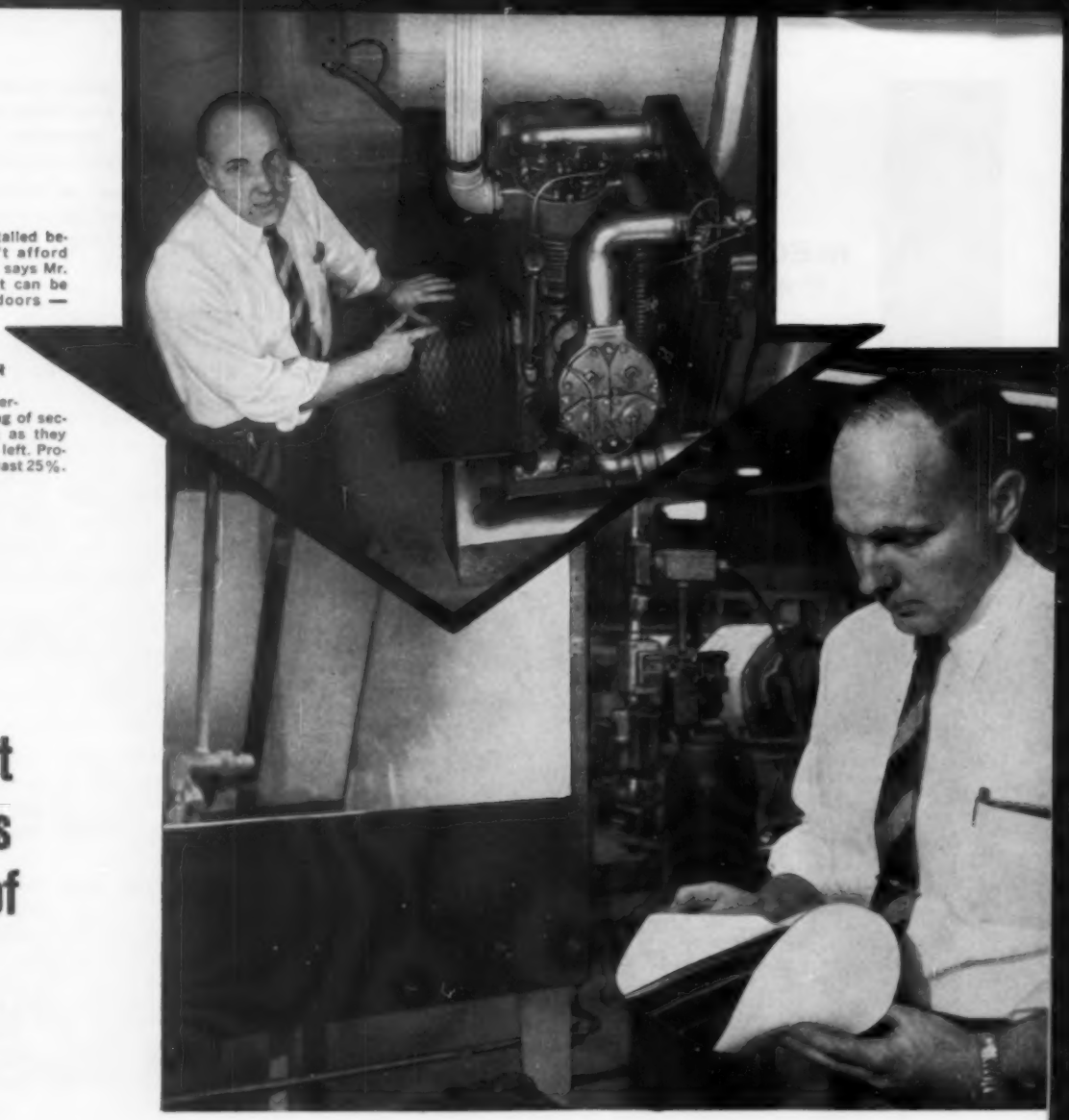
GARLOCK

Contact your Garlock representative at the nearest of our 26 sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-121, Garlock Inc., Palmyra, N. Y.

Canadian Division: Garlock of Canada Ltd.

Order from the Garlock 2,000 . . . two thousand different types of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products

*Registered Trademark



LE ROI 50S2 was installed because Bowes couldn't afford compressor downtime, says Mr. LaFara. Air-cooled unit can be used indoors or outdoors — needs no plumbing.

FINISHED TIRE REPAIR SECTION is inspected. Compressed air now permits automatic spraying of sections with liquid latex as they pass through booth at left. Production increased at least 25%.

This plant minimizes the risk of "no air - no work" with a

LE ROI 50HP STATIONARY COMPRESSOR

A dependable compressor headed the list of critical needs when Bowes Seal Fast Corp., of Indianapolis, Ind., merged two plants under one roof. A Le Roi 50S2 two-stage compressor provides this vital dependability . . . and all the compressed air needed to produce over 2000 various items for the upkeep of cars, tires, and tubes.

James S. LaFara, Plant Manager, reports that the Le Roi unit delivers 210 cfm at 125 psi . . . operates 75% to 80% of 8- to 16-hour production days, five days a week, and supplies almost 100% of all the compressed air needed. Down-time, he adds, is at a minimum, and maintenance costs are below those of two smaller compressors which the Le Roi replaced, and which now serve only as standby units.

Look what this Le Roi 50S2 does! It provides air to spray tire-repair sections (boots) and tubeless-tire repair plugs with a mixture of liquid soap and water. The unit powers latex spraying machines, and blows scraps from tube-patch cutting machines. Other uses include air for lead moulding equipment, nut-driving units, cleaning vents on chemical filling machines, and for the plant's fire-protection system.

Are you looking for a "dependable" compressor? Check the complete line of Westinghouse unit-type and Le Roi stationary air compressors — from ½ to 100 hp. Contact your Le Roi distributor, or write to Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wisconsin.

SC-08

LE ROI STATIONARY COMPRESSORS

PORTABLE AND TRACTAIR® AIR COMPRESSORS • STATIONARY AIR COMPRESSORS • AIR TOOLS

KEELAVITE
Hydraulics

GEAR PUMP / MOTORS

One of the new heavy duty gear pump/motors designed for high continuous rating.

Within the wide range of the KEELAVITE G SERIES of GEAR PUMP/MOTORS, there is a unit suitable for any industrial use. Used as pumps, output ranges from 2.25 gpm. to 180 gpm. Motor torque ranges from 10.5 lb. ins. per 100 psi to 785 lb. ins. per 100 psi.

All of the KEELAVITE PUMP/MOTORS conform to a high standard of workmanship in manufacture, and are reversible without alteration in assembly. The whole range stems from six basic sizes and common components are used within each basic size. All units incorporate roller bearings.

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

For full details write to—

KEELAVITE
Hydraulics

KEELAVITE HYDRAULICS LTD, ALLESLEY, COVENTRY

Telephone: Meriden 441

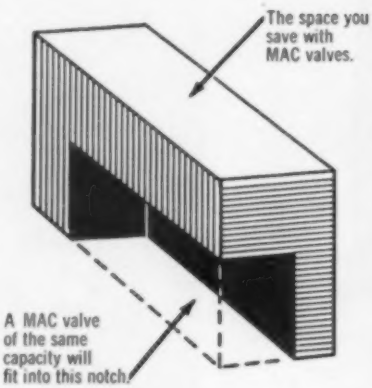
Cuts Air-Valve Size 67% with New Design

Also Boosts Performance, Life, and Ease of Service

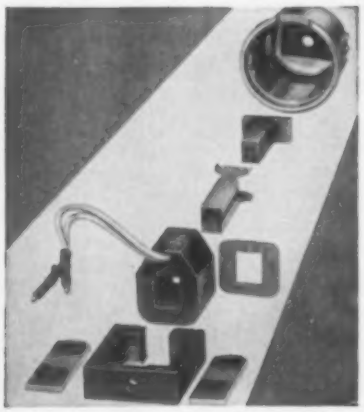
A remarkable new line of pilot-operated air-valves—the MAC series 300—cuts space requirements to ⅓ of that normally required for valves of equal capacity rating.

Not only is the valve extremely simple in operation, reducing cost, but the three moving parts can be replaced in a matter of 1 to 2 minutes without special tools. Life of moving parts is rated at 30,000,000 cycles, minimum.

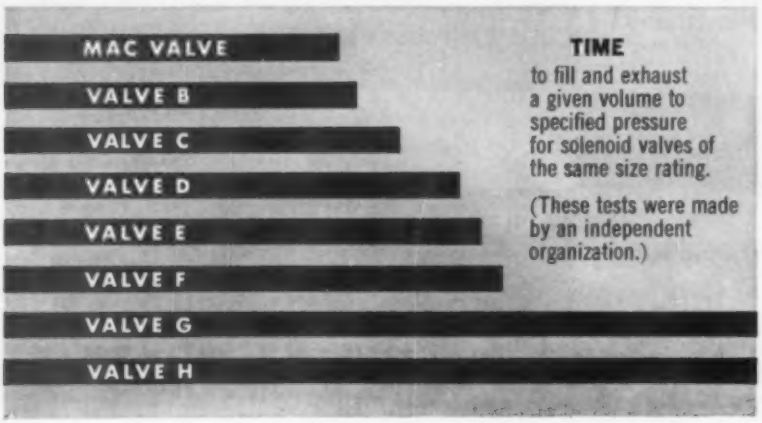
The story of how this was accomplished, together with valve sizes and specifications, is contained in Bulletin #300A available from Mechanical Air Controls on request.



New Solenoid Boosts Valve Life —Virtually Foolproof, it also has Lighter Draw



A virtually failure proof solenoid which can be completely assembled or taken apart without any tools—but which can't be assembled wrong has been developed by Mechanical Air Controls. It has no welds to break or crack. It has no screws, nuts, bolts or other fasteners to work loose. It has a fully encapsulated water and oil resistant coil. There is no wiring through air valve body. The connections just plug in. The entire assembly floats on rubber mounts, the rubber being in shear. The solenoid has a lower draw because of the lighter push required. The design provides for both locking and manual jogging. It is standard on every MAC series 300 air valve.



advances in
PNEUMATICS

MAC

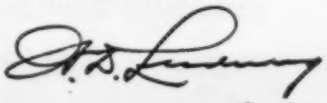
designing an air valve . . .

There are two ways to design air-valves. One is for a specific job, and no more. For example, a valve in a missile usually has to function only once. Wear life is no problem. The other way is to design a valve for the *toughest* job it might face and then use it on easier jobs, too.

Any engineer would prefer the second way, but he wonders "Won't it cost too much?"; or "Won't I be criticized for providing more performance or life than needed?"

His worries are pointless. The second way doesn't have to cost more. Extra performance and quality can be a free "plus." If you design air-valves for the TOUGHEST jobs they can encounter (as we did at MAC) you can naturally get a simpler, more compact, easier-to-service valve; plus extra performance reserve—all AT LOWER COST.

Why? Once the valve licked the toughest application—where speed, reliability, serviceability and life were MOST vital—we simply standardized for mass production. That's how we wound up with a better and lower cost valve . . . the series 300.



President

MAC

MECHANICAL AIR CONTROLS, INC.
10030 Capital, Oak Park • Detroit 37, Michigan

New! FREE CUSHIONS*

MEAD
DURA-LIFE
CYLINDERS

Compare these prices!

1½" Bore — $29.95	**3¼" Bore — $46.40**
2½" Bore — $37.80	**4" Bore — $53.35**

Prices slightly higher West of Rockies.

Write for complete Mead Air Power Catalog

MEAD SPECIALTIES COMPANY • 4114 N. Knox, Dept. 160 Chicago 41

USEFUL LITERATURE

For your free copy of publications reviewed, fill in the reader service card

SMALL CYLINDERS

Steel tube has honed ID. U-packings. Bronze heads and piston. Hard chrome rod. For air to 250 psi, hydraulic to 750 psi. Bores are ¾", 1", and 1 3/16". *Paragon Mfg. Corp., Cleveland, Ohio.*

Circle **400** on Time-Saver Card

HOSE & HOSE ENDS

Covers low pressure, medium pressure, medium high pressure, high pressure and spiral wound hose. Data on type of hose for wide range of chemical agents, pressures, bend radii, and temperature limits. Selection data on hose ends. Assembly instructions. *Weatherhead Co., Ft. Wayne, Indiana.*

Circle **401** on Time-Saver Card

FLOW REGULATOR

Controls flow as low as 35 ccpm. High-strength, heat-treated, cast aluminum body. Hardened steel internal parts. For panel mounting. Can be installed in test stands, or bracket-mounted. Built-in check valve for free flow in reverse direction. Adjustable between 2 and 90 cipm. *Fluid Power Acessories, Inc., Glenview, Illinois.*

Circle **402** on Time-Saver Card

MARINE HYDRAULIC PUMPS, FLUID MOTORS

Constant and variable-volume axial-piston pumps to 115 gpm. Loaded shaft bearings keep effects of outboard loading from reaching pump's inner workings. No unbalance or twisting to unseat cylinder barrel from port plate. Fluid motors to 373 in.-lb. per 100 psi. Continuous service to 3500 or 5000 psi. Pumps available with built-in replenishing pump (to supercharge), pressure control and forced circulation (to cool), and relief and replenishing valves. Meet MIL-P-17869A.. Bulletin 202 has charts, photos, cutaway drawings. Outlines marine uses of pumps, motors, and valves. 12 pages. *Denison Engineering Div., American Brake Shoe Co., Columbus, Ohio.*

Circle **403** on Time-Saver Card

CARTRIDGE-TYPE CONTROL VALVES

Valves put inside cylinder, manifold, or even control handle. Four-page bulletin pictures and describes four ⅛" and ¼" models. Drawings show different ways of operating valves. Valves save space, time, weight. Simplify design. *Humphrey Products Div., General Gas Light Co., Kalamazoo, Mich.*

Circle **404** on Time-Saver Card

STAINLESS STEEL & HIGH ALLOY TUBING

Catalog has data on 12 types of tubing and piping. Engineering data section explains joining methods, welding and bending techniques, and installation hints. Materials analysis. Size ranges given. Bursting and test pressures. Theoretical weights of stainless steel tubing. Corrosion data. Welded tube mill limits. Temperature conversion table. 48 pages. *Trent Tube Co., East Troy, Wis.*

Circle **405** on Time-Saver Card

SPECIAL RUBBER COMPOUND

Special rubber products compounded and molded to specifications—to resist temperature extremes, acids, alkalies, petroleum derivatives, abrasion, vibration, paints, varnishes, and solvents. Silicol silicone rubber won't melt or harden at high temperatures. Chemical stability over 650 F range. Resists weather, arcing, ozone, and fungi. Some Silicols have same shrinkage as organic rubber. Can be compounded for high strength, low compression set, low moisture absorption, extreme low temperature, and high aging resistance. No plasticizers or anti-oxidizing materials. Sheets for die-cutting and fabrication by user. Nylon and glass-fiber-impregnated Silicol available for custom compounding. Bulletin C-60 describes facilities. Shows examples of custom jobs. *Colonial Rubber Co., Ravenna, Ohio.*

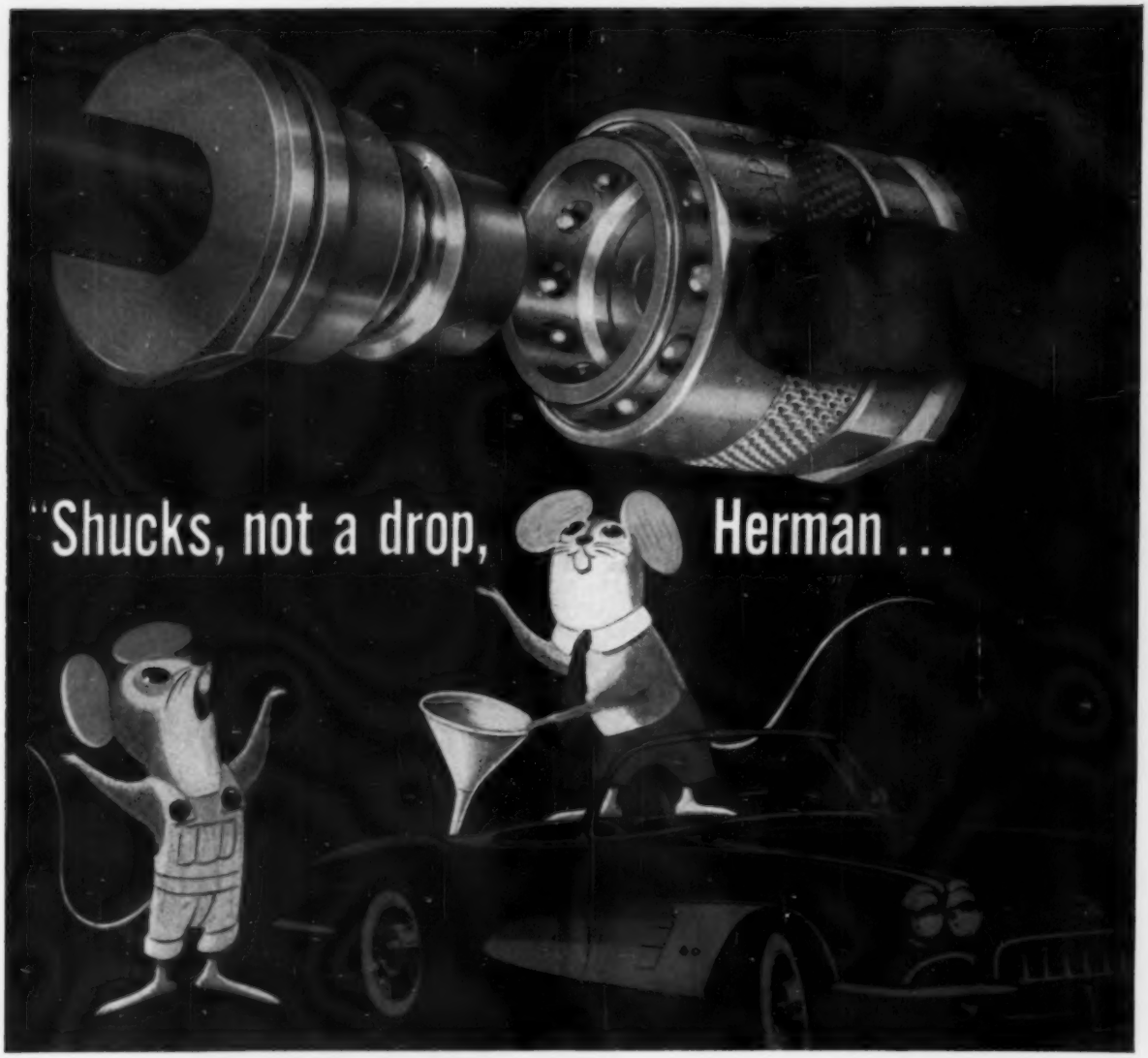
Circle **406** on Time-Saver Card

ELECTROHYDRAULIC SERVO COMPONENTS & SYSTEMS

Summary of principles and potential applications of electrohydraulic servocontrol mechanisms. Describes types and applications of servovalves. Case histories. Diagrams and drawings. Shows line of industrial components. *Moog Servocontrols, Inc., East Aurora, N. Y.*

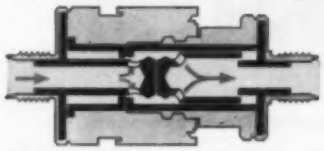
Circle **407** on Time-Saver Card

For more reviews of FREE LITERATURE turn to page 136

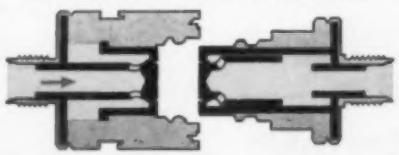


. . . it's a no-spill valved coupling by Snap-Tite!"

To use Snap-Tite Valved Coupling:



CONNECT—Full flow instantly



DISCONNECT—Stop flow instantly

The 15 Series valved coupling automatically snaps off the flow of the most volatile fluids when disconnected—with no leakage.

Snap-Tite's 15 Series valved coupling contains valves in both sections. Thus, the only fluid lost is that which clings to the outer metal surfaces. This coupling meets military specifications and can be used with fuels and other fluids to 3000 psi working pressure and 400°F. Sizes: ¼", ½", ¾", 1" in 6061T6 aluminum anodized; ⅜" in steel (electroless nickel plated), and 6061T6 aluminum.

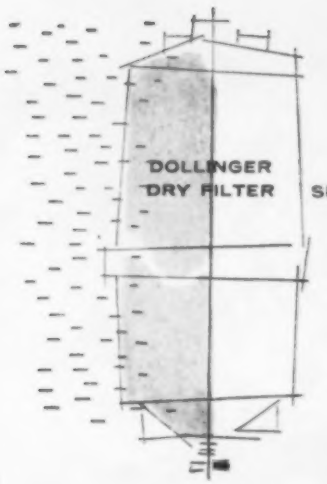
Snap-Tite can provide the right valved coupling—with quick off-on action wherever coupling or shut-off is required—for most any use, most any fluid.

For more information, write for Snap-Tite Catalog #15. Snap-Tite representatives in all principal cities.

Snap-tite

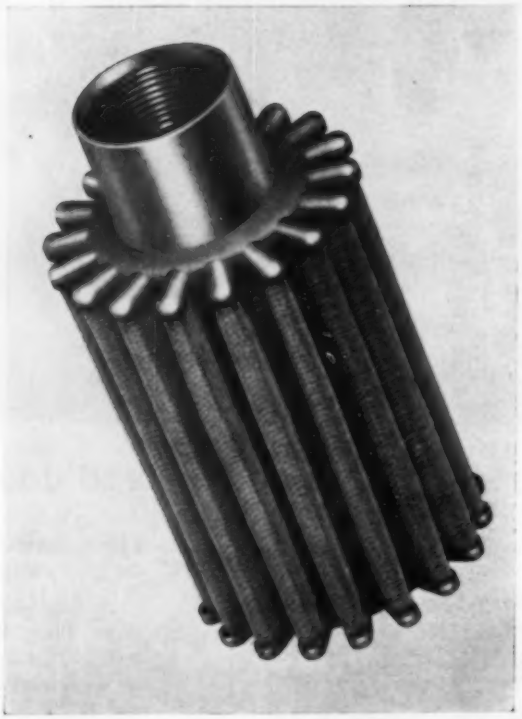
UNION CITY, PA.

ST-59-03



SPECIALISTS
FOR 39 YEARS

ALL NEW DESIGN...



Filters for Sump Pumps and Hydraulically Operated Equipment

AT A NEW LOW PRICE

Dollinger Sump Filters are priced lower than competitors' filters for the simple reason they have been specifically designed for your needs. Leading hydraulic equipment manufacturers have already standardized on these filters for their products.

Molded End Seals Reduce Cost

New method of manufacture results in lower production costs. Special plastic impervious to all synthetic oils, mild acids, coolants, and water to 300° F.

One Piece Construction

Positive protection against dirt, sludge, rust and abrasive particles causing pump failure.

Exclusive Radial Fin Design

Permits larger filter capacity in smaller area. Models are available in either 60 or 100 mesh screen depending on efficiency desired.

Eight standard sizes are available with capacities from 5 to 100 GPM. Get complete details; write for Sump Filter Bulletin 330. Dollinger Corporation, 65 Centre Park, Rochester 3, N. Y.

STAYNEW FILTERS

DOLLINGER

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

300 HOUSINGS PER HOUR

produced on Greenlee machine— with assist from VICKERS *hydraulics*

Here's a Greenlee transfer machine that produces 300 steering gear housings per hour while performing a total of 114 close tolerance machining operations. This outstanding performance record is achieved because the machine combines advanced design ideas with the best available components.

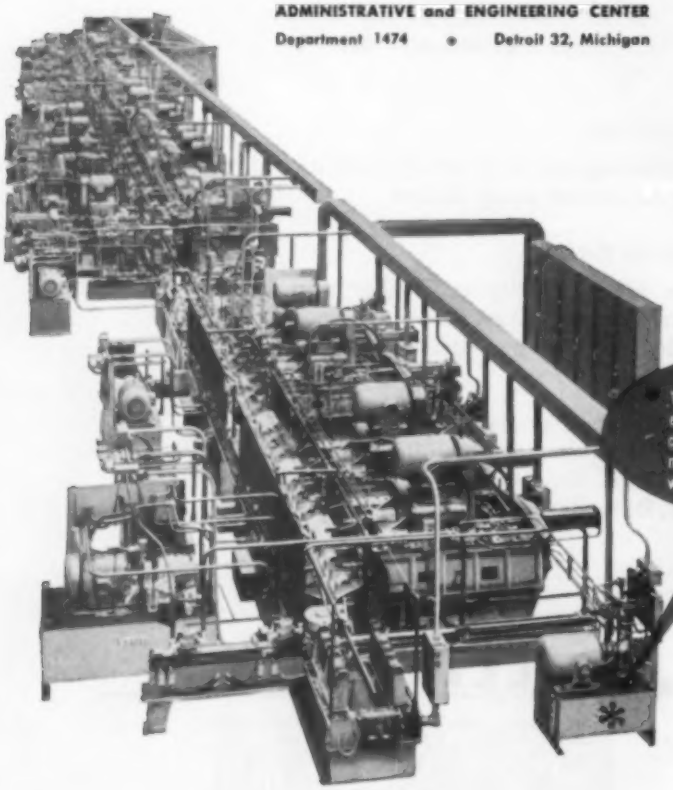
Self-contained Vickers hydraulic power packages provide controlled power for clamping the pallet-mounted workpieces in precise position at each work station, driving transfer mechanisms and for movement of certain machine heads. These power packages are designed to JIC (Joint Industry Conference) standards which means easy maintenance and minimum downtime to you.

Vickers offers you power packages, either standard or custom engineered that provide an almost unlimited number of choices to meet your specific technical requirements. You can choose from the broadest product line in the industry any combination of controls for use with single, double, two-pressure or two-stage pumps (the latter for pressures to 2000 psi), and for variable and constant delivery pumps to 5000 psi. Your choice of components will be packaged with the size or shape reservoir best suited for your job.

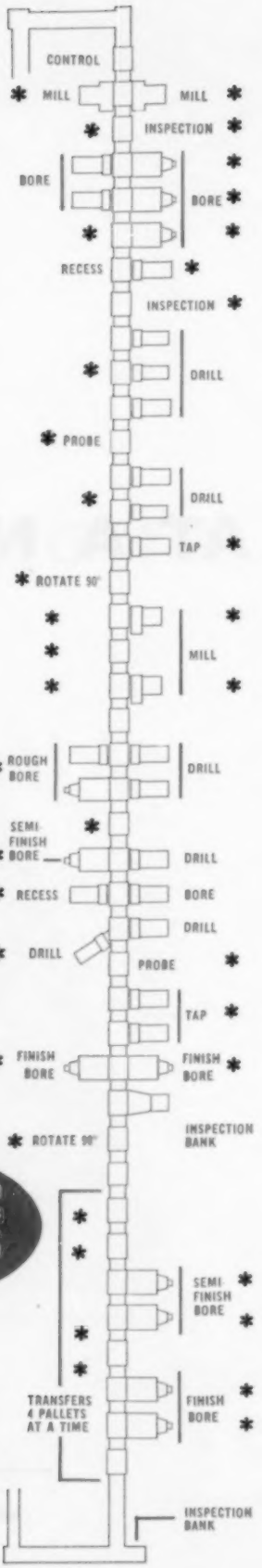
Whether the Vickers power package you choose is standard or custom engineered, you save money and time because it comes *ready-to-go*—designed and assembled to the highest standard of quality by hydraulic specialists.

Get more data by writing today for Bulletin 5001C or by consulting your nearby Vickers application engineer.

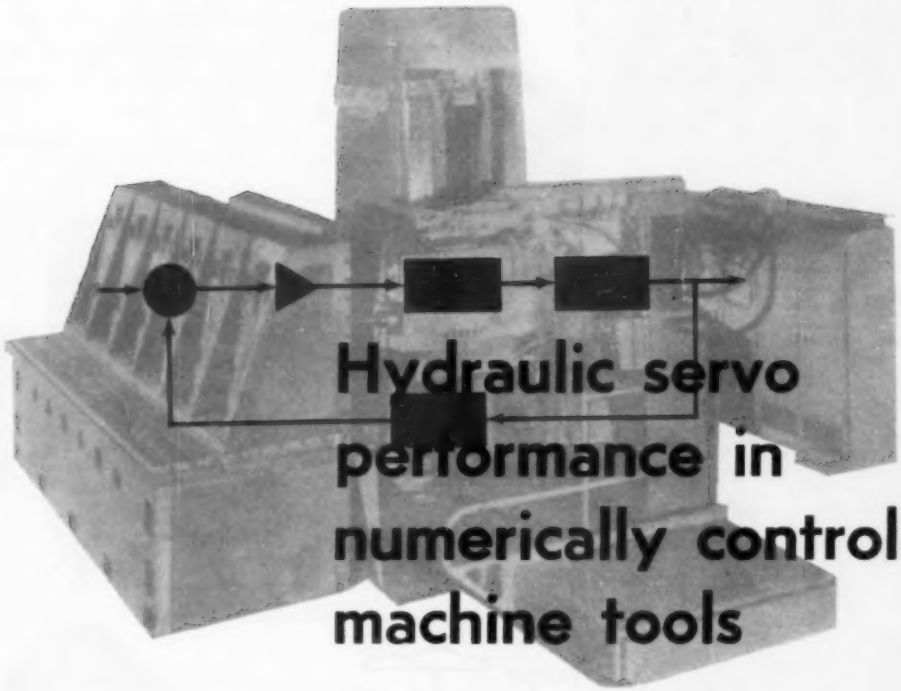
VICKERS INCORPORATED 8514
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1474 • Detroit 32, Michigan



Vickers power packages supply fluid energy for fast, precise, automatic clamping, transfer and head movement at station locations marked with asterisk.



Hydraulics & Pneumatics
JUNE 1960



Hydraulic servo performance in numerically controlled machine tools

● By F. J. CIZEK, *Staff Engineer, Industrial Controls Section*
Bendix Corporation, Detroit, Michigan

A numerically controlled machine tool gets its instructions from punched or magnetic tape. In a typical system, a photoelectric tape reader reads a block of information on the punched tape and temporarily stores the information. An interpolator then takes information and generates command pulses for each axis of motion.

The number of pulses generated for each axis is proportional to the distance the machine slide must move. The pulse rate is proportional to the slide's speed.

Feedback devices (quantizers) are attached to each machine slide. They measure the slide movement and produce feedback pulses. Each feedback pulse is equal to the same distance as a command pulse.

Error registers for each machine axis, receive command pulses from the interpolator, and feedback pulses from the quantizer through a synchronizer. These signals are compared and their ac-

cumulated difference (error signal) is transmitted as a voltage to a servo amplifier. After amplification and compensation, the voltage drives a torque motor, servo valve, and hydraulic actuator (motor or ram). This actuator drives the load.

HIGH performance, numerically controlled machine tools have a servo system which can change direction and velocity fast, with minimum error.

A typical system from the summing junction forward, is shown in Figure 1.

Using LaPlace transforms, the forward loop transfer function from the valve spool to the quantizer is:

$$K_3G_3(s) = \frac{\theta_o(s)}{X_1(s)}$$

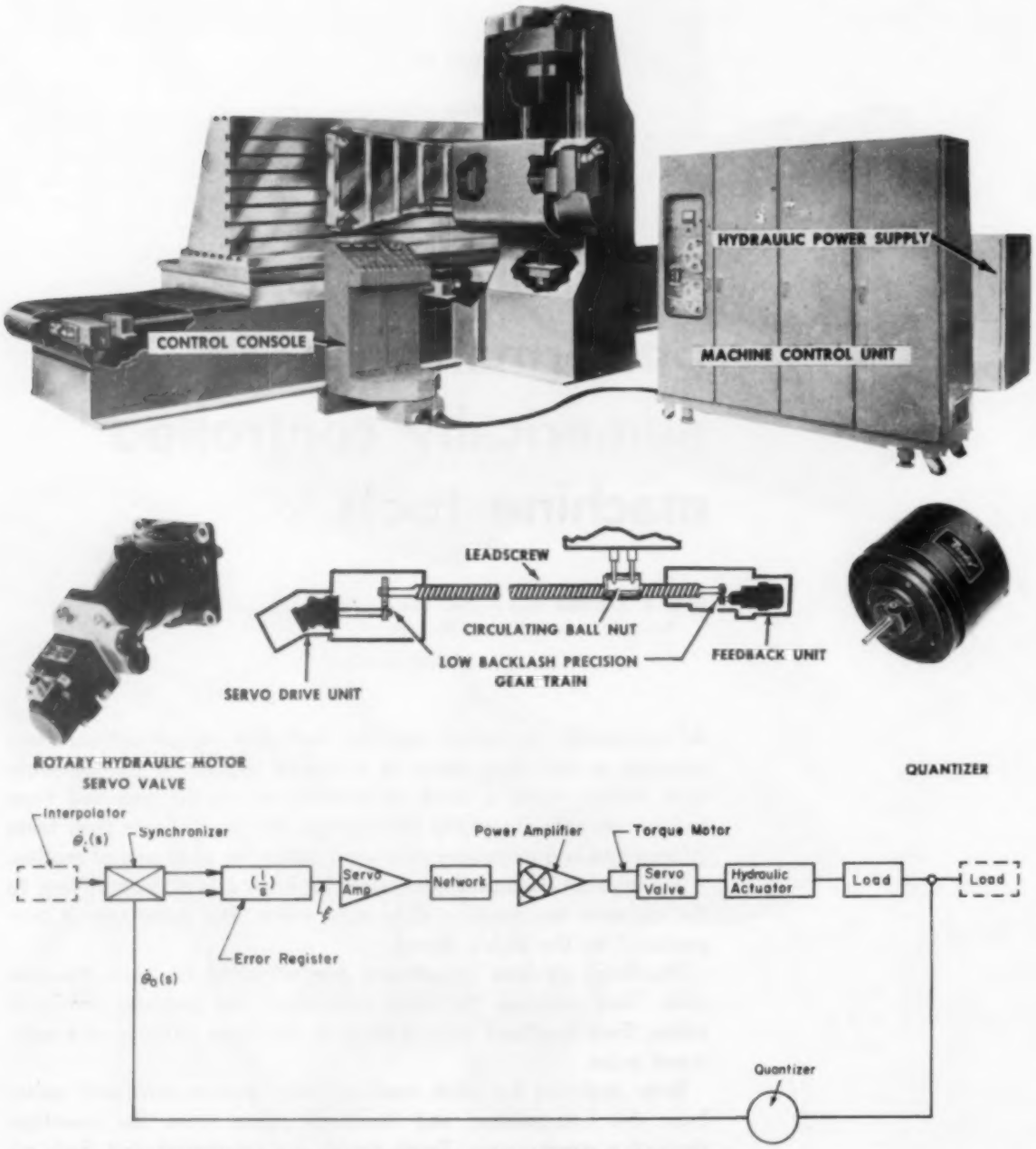


FIG. 1. BLOCK DIAGRAM and mechanical arrangement of a typical machine tool, servo system.

$$= \frac{K_3 [\alpha s^2 + \beta s + 1]}{s(\gamma s^4 + \zeta s^3 + \epsilon s^2 + \eta s + 1)} \quad (1)$$

where: θ_o = Output position, counts
X_1 = Spool position, inches
K_3 = Gain factor (including gear ratio, valve gain, motor displacement, pulse value).
$\alpha, \beta, \gamma, \zeta, \epsilon, \eta$ = Damping factors, inertia factors, and time constants.

The torque motor-to-spool transfer function for a typical, constant pressure, servo valve can be approximated by the linear, third order system:

$$K_1 G_2(s) = \frac{X_1(s)}{\Delta_1(s)} = \frac{K_1}{(As^3 + Bs^2 + Cs + 1)} \quad (2)$$

where: K_1 = Gain and conversion factor
Δ_1 = Differential current, ma.
A, B, C, = Torque motor parameters and time constants.

The forward loop, electrical network and amplifiers can be represented by:

$$K_a G_1(s) = \frac{\Delta_1}{\xi} = \frac{K_p K_1 (T_2 s + 1)}{T_1 s + 1} \quad (3)$$

where: ξ = Position error, counts
K_p = Conversion factor (including amplifier gain)
K_1 = Conversion factor
K_a = Overall gain factor
T_1, T_2 = Time constants, seconds

If each of the elements is isolated, overall, open-loop transfer function is:

$$G_o(s) = \frac{\theta_o(s)}{\xi(s)}$$

$$= K_a K_1 K_3 [G_1(s) \times G_2(s) \times G_3(s)] \quad (4)$$

This gives a picture of system dynamics.

• **Following error**—Consider $K_1 K_3$ as the servo drive and load gain, or simply hydro-mechanical gain, K_{HM}. If K_v is defined as the value of $sG_o(j\omega)$ as ω approaches O, then.

$$K_v = K_a K_{HM} \ [Sec^{-1}] \quad (5)$$

This describes the contour-following error. Carrying this further:

$$\xi_{ss} = \frac{V_{ss}}{K_v} \quad (6)$$

where:
ξ_{ss} = Steady state following error, counts
V_{ss} = Steady state velocity, counts/second.

Many practical hydraulic systems have K_v values over 3000.

For a hydraulic servo in which K_{HM} is 667 pulses/sec/ma and gain factor K_a is 6 ma/pulse, K_v is 4000 sec^{-1}. Following error is then less than 2 pulses at 90 ipm.

This example is from an actual system in which the pulse value is 0.0002 inches. The servo drives a slide which weighs over 20 tons. Closed loop, transient response to a step of velocity and steady state error are shown in Figure 2. This response was measured at the input to the servo amplifier (refer to the block diagram, Figure 1).

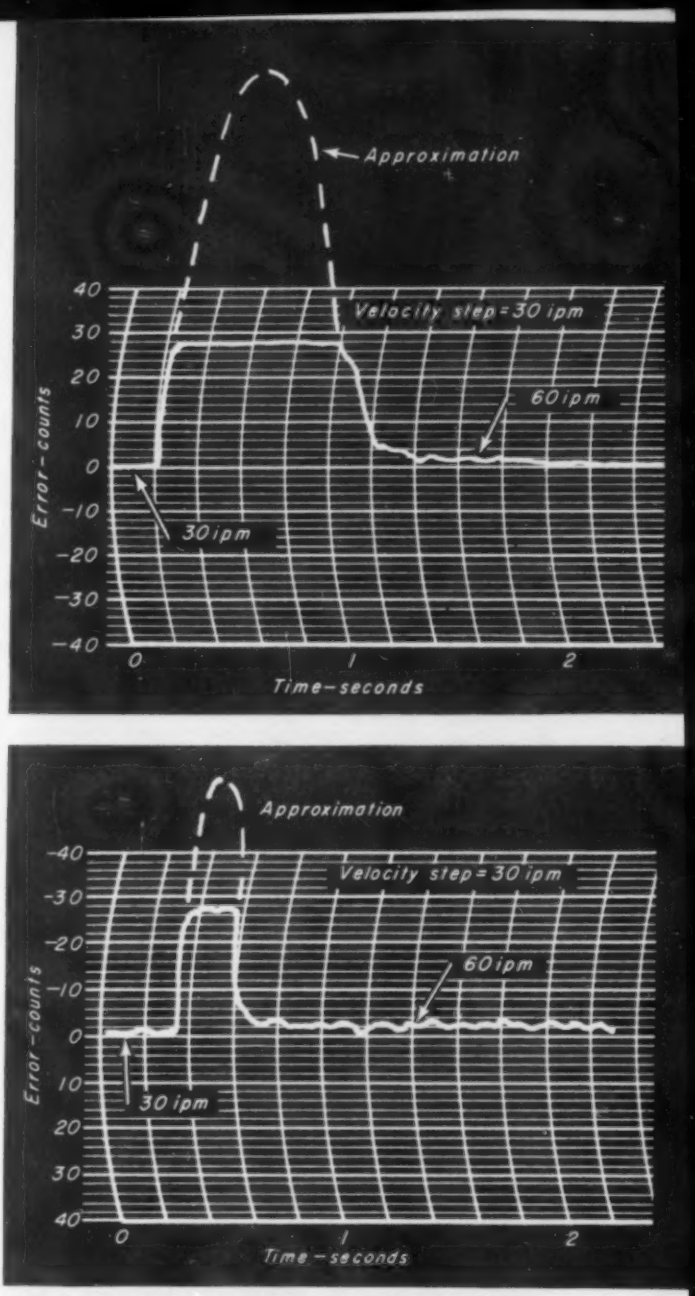


FIG. 2. ENLARGED PEN RECORDING OF CLOSED LOOP TRANSIENT RESPONSE of 20-ton milling machine slide. Above, with network initially installed. Below, after network change.

• **Load force sensitivity**—Another useful system parameter is load force sensitivity. The transfer function for the relation between spool movement and axial force at the slide, with zero output motion is:

$$K_4 G_4(s) = \frac{F_L(s)}{X_1(s)} = \frac{K_o K}{(a + bs)} \quad (7)$$

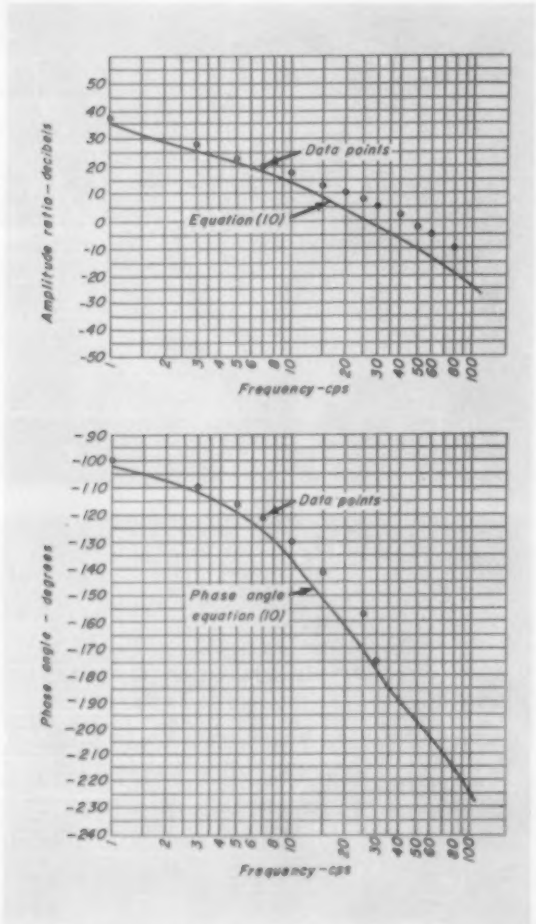


FIG. 3. OPEN LOOP FREQUENCY RESPONSE CURVES for a lathe type machine tool slide at average speed and load.

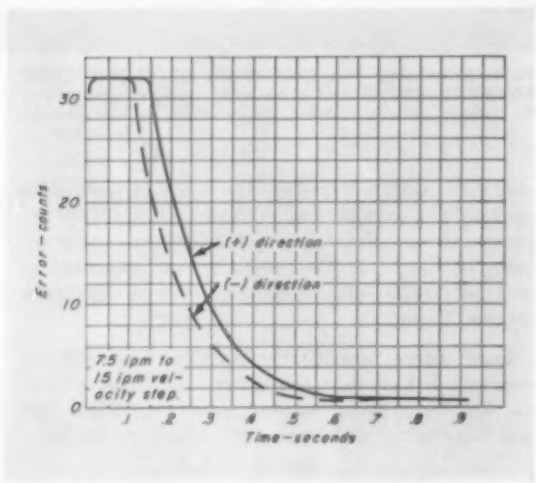


FIG. 4. CLOSED LOOP TRANSIENT RESPONSE for machine slide of Fig. 3.

where: K_4 = Overall gain factor
K_v = Valve gain
K = Gain and conversion factor
a, b = Hydraulic system parameters
F_L = Axial force at the slide, pounds

Combining equations (2), (3) and (7):

$$G_F(s) = \frac{F_L(s)}{\xi(s)}$$

$$= K_a K_1 K_4 [G_1(s) \times G_2(s) \times G_4(s)] \qquad (8)$$

Considering K_1K_4 as hydro-mechanical force gain, K_{HF} and defining K_F as the value of $G_F(j\omega)$ as ω approaches 0 in equation (8), the force constant, K_F, is:

$$K_F = K_a K_{HF} \text{ lb/count} \qquad (9)$$

In terms of stiffness, units of equation (9) can be converted to lb/inch, giving a possible value for hydraulically driven machines over 20 x 10^6 lbs/in.

The two constants, K_v and K_F affect the machine tool performance at low feed rates and in the presence of large forces, respectively. For machine tools especially where feedback is from the slide (such as a rack and pinion), the higher these values, the smoother the slide operation, and the smaller the following error.

Equations (7) and (9) show that the valve, torque motor, and amplifier must have large gains for high values of K_F. Also equation (7) shows that parameter a should be small. This is directly proportional to hydraulic actuator leakage, and inversely proportional to actuator displacement. Obviously, a small leakage and large displacement combine to increase K_F.

Referring to Figure 2 (top), it takes more than one second for the servo to reach 60 ipm after a velocity step input. The dotted curve shows approximately the actual instantaneous position error during the time of error register saturation. For some contour applications, this total error may be too large, and the time of recovery too great. The lower curve of Figure 2 shows the same system modified by changing the network to have an increased response.

Instantaneous maximum position error and the time constant have been reduced. This has been done at the expense of lowering K_v as shown by the slightly higher following error.

• **Performance limitations**—There are performance limitations in all systems, or time constant and maximum error could be reduced without bounds.

What are these limits? Servo stability is the most important. This depends on all elements, but in machine tools the drive, slide, and feedback are the most critical.

Before the loop is closed, certain stability criteria must be applied to the open loop dynamics.

Referring again to equation (4), several stability criteria can be applied to this equation. However, if we apply the one that states the compensated open loop frequency response must have a positive phase margin at 0 db, it must reach this point before a phase shift of 180°. Remember, the 180° phase angle is an important determinant of system stability. Components which contribute most to phase shift are represented analytically by equations (1) and (2) which combine to

HOW HYDRAULIC COMPONENTS AFFECT SYSTEM PERFORMANCE

DIRT—A small particle of dirt or metal can severely reduce valve response. Good filters are necessary either in the valves, at the power source, or both. A new system should be flushed before use.

SUPPLY PRESSURE VARIATION—A constant supply pressure is nearly impossible because power source dynamics are in the system. Tests show that for a well built power supply regulated by a simple relief valve, with small inputs, supply pressure variation is less than 10% (sometimes less than 5%). This variation does not affect the 180° phase point significantly. A sudden, large movement of the valve spool will drop supply pressure instantly, but with proper design, this drop can be minimized so it has little effect on system response.

TEMPERATURE—An oil temperature variation from 90 to 120 F does not affect the 180° phase point.

VALVE AND TORQUE MOTOR HYSTERESIS—With today's high performance, precision valves and their low hysteresis (total band of less than 3%) this is negligible in most cases.

RAM OR MOTOR FRICTION—Negligible in most cases. Anticipated effects of negative friction have been analyzed, though negative friction tests have not been made, it has caused no instability on highly sensitive machines.

OIL VOLUME UNDER COMPRESSION—Oil volume under compression is a major factor in performance since it adds compliance to the system. It depends on oil volume in passages between the valve and actuator (motor or ram) in the actuator itself, and in the lines to the valve. One may use, for example, the ram with its large cylinder volume and thus a compliant spring or a motor-gear-box-lead screw where the lead screw and its axial deflection become the compliant element.

Oil volume in the lines ahead of the valve contribute supply pressure variations.

PHASE SHIFT DUE TO VALVE AND TORQUE MOTOR—Even with the highest performance valve, this phase shift can be significant, especially in low performance systems. Such a valve can cause 10° phase shift at 10 cps with a system pressure of 500 psi or less. To decrease this phase shift pressure could be increased, but sometimes this is uneconomical.

give:

$$\frac{\theta_o(s)}{\Delta_i(s)} = K_3K_i[G_2(s) \times G_3(s)] \qquad (10)$$

These were also used to derive equation (4). Figure 3 is a sample plot of equation (10) for a lathe type machine tool slide, presently in production use, for a particular set of conditions of average speed and load.

The frequency response curves are based on the Small Perturbation Theory. The plot is for one region of hydraulic motor and valve operation. Actual test points are also shown. These curves show that 180° phase shift for the valve, motor, and drive is at a frequency of 32 cps on the analytical curve. In general, the higher this frequency, the greater will be the servo closed loop response. From this, the best approximate settling time for a step input of velocity for this closed loop would be estimated at about .15 seconds. The discrepancy between test results and theoretical results in Figure 3 is because average speed and gain during test were not exactly those assumed for the theoretical analysis.

The closed loop transient response for the machine of Figure 3 is shown in Figure 4. Settling time is actually .5 seconds. This is more than the open-loop plot estimate because of the margin of stability desired.

• **Parameters affecting phase shift**—For the hydromechanical elements, in strictly linear cases, damping, springs and masses determine the 180° phase angle frequency. Because no machine tool is strictly linear, gear teeth inaccuracies, backlash, friction, hysteresis, and variations in supply pressure and flow should also be considered. Valve and hydraulic power supply characteristics also affect this frequency. The frequency response data in Figure 3 are for one region of operation, so pressure-flow relationship of the valve and motor combination show a greater phase shift at higher speeds or in another region of operation.

Even though the frequency response method using the Small Perturbation Theory does not hold for large magnitude inputs, it gives a good indication of actual response when used on a region-to-region basis. If a system is stable for all regions, it can be assumed that it will be stable for the entire range of operating conditions. This assumption works well for most machine tools. Where the assumption cannot be made, some non-linear method may be used. Digital or analog computer studies can also aid in solving these problems. ▼▼▼

Electrohydraulic servovalves in industry

• By **HARVARD B. KOLM**, *Manager, Industrial Division, Moog Servocontrols, East Aurora, N. Y.*

PART 1 — TYPES OF SERVOVALVES

Electrohydraulic technology and components were originally developed to solve guidance and stabilization problems in missiles and supersonic aircraft. Many of the advantages for airborne application are now earning servovalves an important place in industrial control.

ELECTROHYDRAULIC control systems transform low power electronic signals into motion or force. For instance, they permit converting electrical guidance signals into aircraft control surface displacements, or electrical voltages from punched tape readers into machine tool cutting positions. They have extremely fast response, low weight and small size in comparison to electromechanical systems using motors of equivalent power. Other advantages are wide speed and force ranges, high accuracy, and long life.

In a typical, manually controlled hydraulic system an operator controls speed and direction by observing machine motions and correcting with a hand-operated valve. This control could not be duplicated electrically until the servovalve was developed. Solenoid valves can control direction, but cannot vary speed continuously because they have fixed operating positions.

PROPORTIONAL SERVOVALVES

These are designed to control flow, load pressure or a combination of both, proportional to an applied electric signal. Although many custom designs have been developed for particular applications, the following basic types handle most industrial applications:

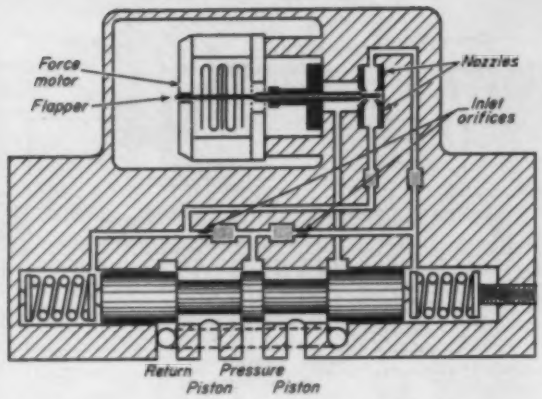
• **Flow control servovalves**—These are the most common in industrial use. Oil flow to and from a motor or cylinder is metered in proportion to an electrical signal, and in a direction corresponding to the polarity of the signal. An applied signal results in a proportional displacement of the servovalve final stage spool. The basic flow equation for a 4-way valve,

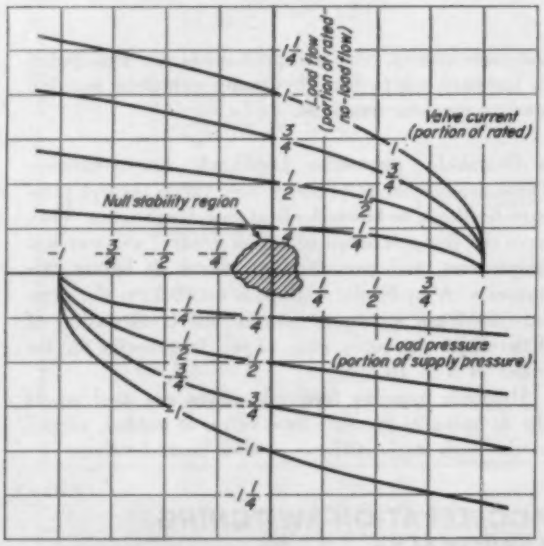
$$Q = KA\sqrt{\frac{P - P_L}{2}}$$

shows that flow is proportional to the metering area uncovered by the spool, and the square root of pressure drop across the valve. Because of this, flow through the servovalve decreases as load pressure increases. When the load pressure equals supply pressure, flow is zero.

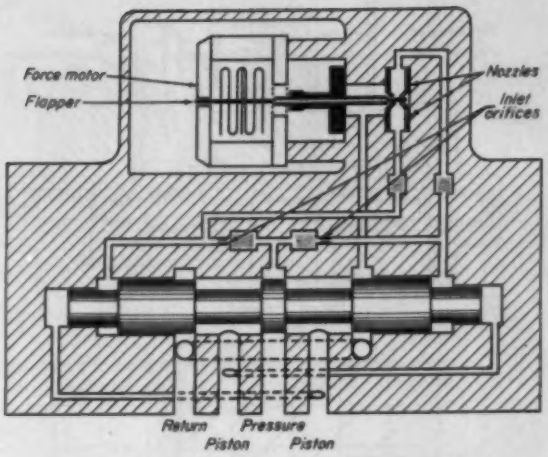
Two-stage flow control servovalves use the first stage (or pilot stage) to proportionally boost the force from an electrically actuated force (or torque) motor. The spool driving force is opposed by spool-centering springs and a flow reaction force which tend to recenter the spool. The flow reaction force (Bernoulli force) influences the flow-versus-load pressure characteristic and may be used to gain some degree of independence from pressure drop.

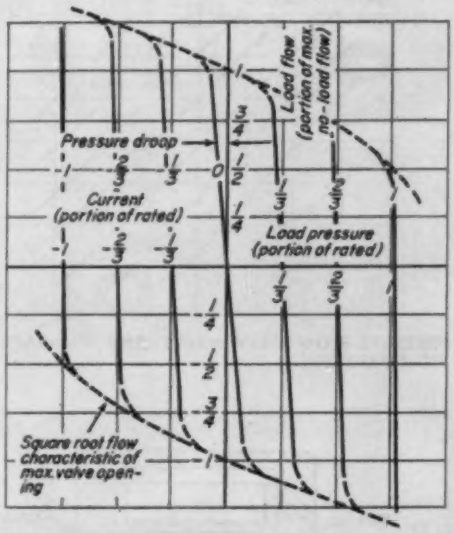
Flow control servovalves are used mostly in systems which maintain position proportional to an electrical reference voltage. They are sometimes used in force servomechanisms and in velocity control systems. With the cylinder ports blocked, a flow control servovalve can develop full system pressure across a motor or cylinder with the application of only a fraction of rated signal. This characteristic, known as static pressure gain, may be tailored by the use of spool metering edge alignment (overlap and underlap) and by the spool's fit. The high static pressure gain of a flow control servovalve makes possible high stiffness in a position servomechanism.




Load flow (portion of rated no-load flow)
Valve current (portion of rated)
Null stability region
Load pressure (portion of supply pressure)

FLOW CONTROL SERVOVALVES AND CHARACTERISTIC CURVES.




Load flow (portion of max. no-load flow)
Pressure droop
Current (portion of rated)
Load pressure (portion of rated)
Square root flow characteristic of max. valve opening

PRESSURE CONTROL SERVOVALVE AND CHARACTERISTIC CURVES.

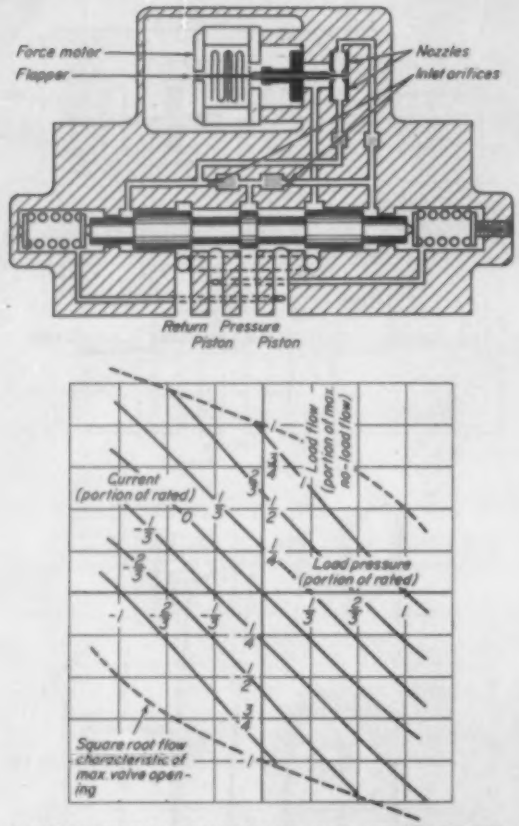
• **Pressure control servovalves**—These control differential pressure across a motor or cylinder (load pressure) in proportion to an applied electrical signal. The first stage develops a differential pressure proportional to the applied signal like a flow control servovalve, but the second stage has no spool-return springs. Instead the spool ends have stub shafts which provide a second pair of spool end areas. The differential pressure from the first stage is applied to one set of areas and the remaining set is internally connected to the cylinder ports.

As a signal is applied to the valve, the spool moves until the load pressure acting on one set of areas balances the force created by the first stage. The flow reaction force also acts on the spool and enters into the force balance as flow passes through the valve to the load. Spool force created by the first stage must counter-balance both the force due to load pressure and the flow reaction force. As a result, the constant signal characteristic curves depart from the ideal vertical. This is called *droop*. Flow characteristics must always be within the square root characteristic curve defining maximum metering area.

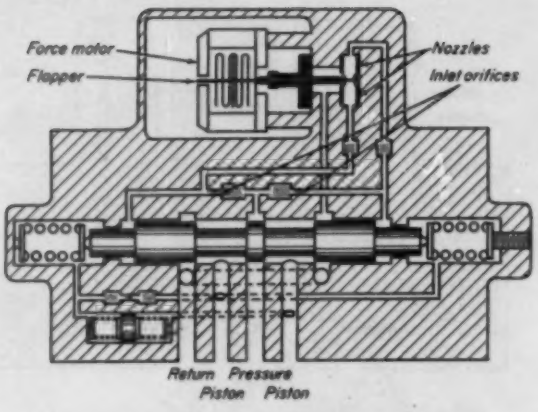
Pressure control valves are ideally suited to open loop controls which program force or torque independently of displacement. For high accuracy it is usual practice to use feedback from a force or torque measuring transducer in association with a flow control valve to create a closed loop servomechanism.

• **Pressure-flow servovalves**—Sometimes called pressure-feedback valves, these combine flow and pressure control. The second stage has both spool-return springs and stub shafts. Flow characteristics are a cross between the flow control valve and the pressure control valve.

Pressure-flow valves are used mostly in position servomechanisms where additional damping is required to improve the response of an otherwise oscillatory load. Missile motor gimbaling systems and radar antenna positioning are two applications. Each has a massive load coupled to the servoactuator through flexible members making an under-damped spring-



PRESSURE-FLOW SERVOVALVE AND CHARACTERISTIC CURVES.



DYNAMIC PRESSURE FEEDBACK SERVOVALVE

and-mass system. Similar applications are anticipated in industry where long hydraulic cylinders position massive machine members.

• **Dynamic pressure feedback servovalves**—These are similar to pressure-flow valves, except pressure feedback is blocked off at low frequencies. They have the characteristics of a flow control valve at low frequencies, and pressure-flow valves at higher frequencies. A hydraulic high-pass network in the pressure feedback passages permits full transmission of differential pressures only above frequencies in the order of 3 to 10 cps.

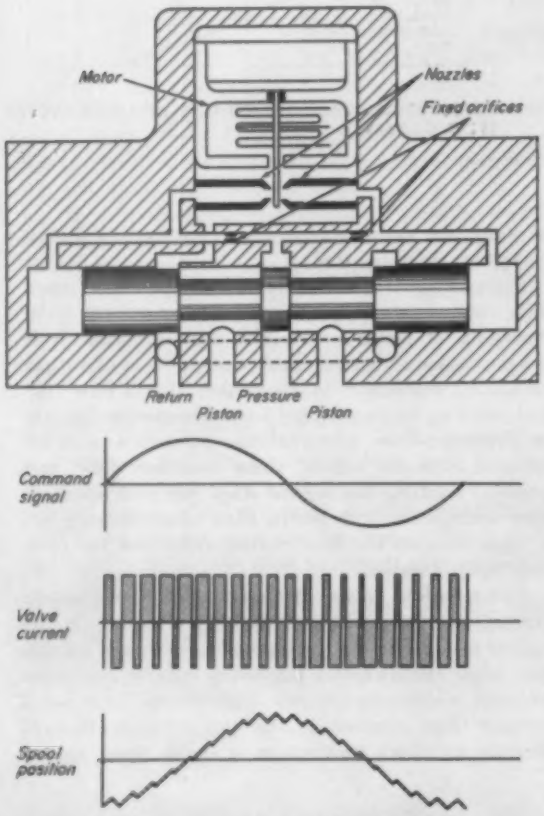
Dynamic pressure feedback valves are used where the damping of pressure-flow valves is needed, as well as the high static stiffness of flow control valves.

ACCELERATION-SWITCHING SERVOVALVE

Based on an entirely different concept, this takes a different approach to servocontrol. Input is time-dependent rather than amplitude-dependent. A square wave input is applied to the first stage and the time difference between positive and negative pulses controls flow. The valve is similar to a flow control, but has no spool return springs. During the extreme excursions of the signal, the first-stage armature tends to close off one nozzle. Resulting flow from the first stage gives a velocity to the second stage, first in one direction, then the other. A time unbalance in the square wave causes the spool to assume a mean velocity away from center, controlling the actuator's acceleration. The actuator's acceleration is proportional to the time unbalance input to the valve. Because of the double integration between the actuator and the signal input, stabilizing networks must be used in the associated paths of the control system.

Acceleration-switching valves are most effective in applications requiring high static stiffness and minimum null shift with temperature and pressure. The control is basically a function of time, not amplitude, and is not affected by amplitude variations. Another benefit is zero velocity error.

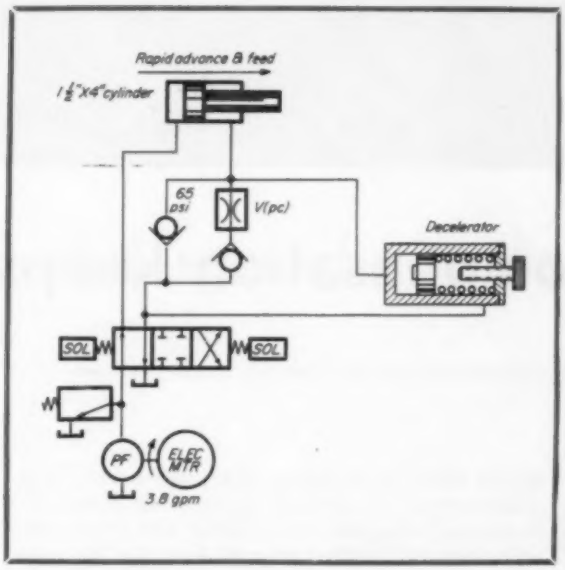
The main disadvantages of an acceleration-switching valve system is that it requires more complex electronic equipment, and there may be switching noise at the load. ▼▼▼



ACCELERATION SWITCHING SERVOVALVE. Curves show system input signal, valve input signal, and resulting valve spool position.

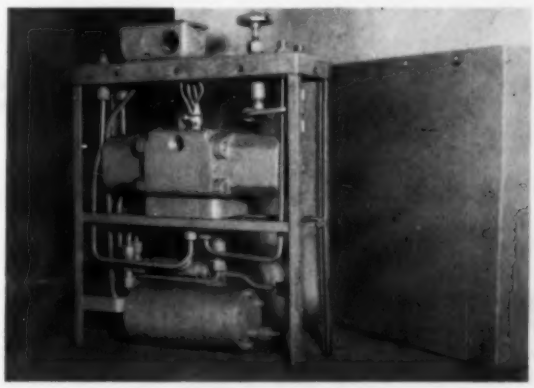
Deceleration without cams

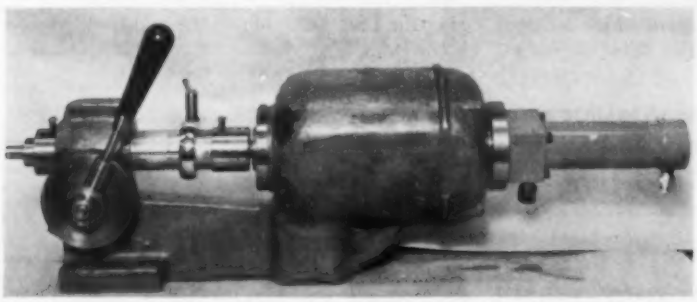
• By **VINCENT C. WEBSTER**, *Hydraulic Engineer, Avey Div., Motch and Merryweather Machinery Co.*
and **PETER COFFARO**, *Pathon Manufacturing Co., Cincinnati, Ohio*



DECELERATOR'S ADJUSTMENT SCREW changes its effective volume and length of the rapid advance stroke. Feed rate is then controlled by a meter-out circuit.

VALVES AND DECELERATOR are enclosed together and mounted on the machine. The decelerator, below, makes the unit compact and saves using a deceleration valve.





DRILL UNIT may be operated manually or by an air or hydraulic cylinder. It exerts 450 lb. thrust at 300 psi.

A DECELERATOR having a floating piston and adjustable stop controls the change from rapid advance to feed for this drill unit. The decelerator eliminates cams usually required with a deceleration valve. It is simple and easily adjustable for speed change point.

During rapid advance, fluid flows out of the cylinder to the decelerator where it pushes the decelerator piston back against a light spring. When the decelerator piston hits the stop, cylinder exhaust flow is through the flow control valve. Feed rate is adjustable over a wide range with the metering-out valve.

Turning the decelerator's adjusting screw changes its effective volume and changes the rapid advance stroke. At the end of the drilling feed, the 4-way valve shifts to retract the cylinder. Because of the 65-psi check valve, the decelerator piston returns before flow goes to the cylinder rod end.

Feed rates are variable from 0 to 5 ipm. Rapid advance is adjustable from 0 to 30 ipm. The decelerator and valves are enclosed in a compact, machine-mounted enclosure. A compact power unit operates up to 10 drill controls set for individual strokes and feeds.

The decelerator can be used without a metering-out valve. It then becomes an adjustable stop for the cylinder. An accumulator or relief valve would probably be needed to prevent shock.

▼▼▼

System pressure on this fluid motor driven saw depends on sawing rate, and varies as much as 800 psi. Without correction for pump and motor slip, band speed would drop as pressure increased. Electric motor speed also decreases slightly with increased torque. These are undesirable, especially at slow speeds where speed decrease is a larger percentage of total speed.

How slip compensation keeps

• By **CHARLES WHITMORE,** *Project Engineer, Continental Machines, Inc., Savage, Minnesota*

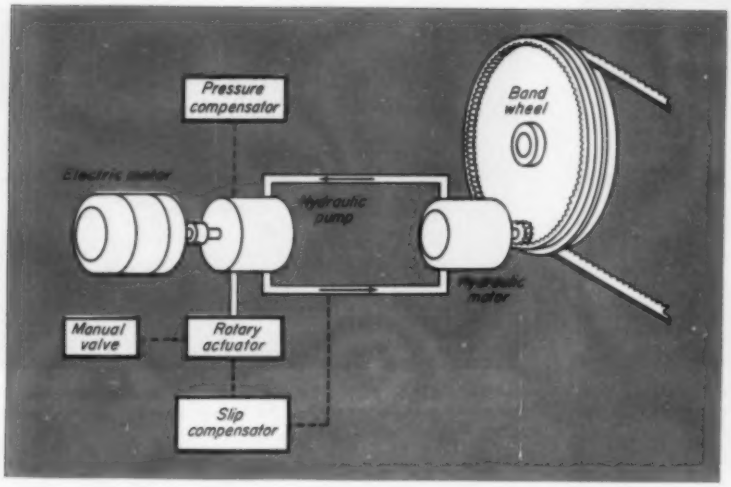
A SIMPLE, stable feedback speed control system for this band saw was too slow. The system we developed gives adequate speed control and a very fast response. It is based on the proportional relation between pressure rise and speed drop.

System pressure acts on a valve spool which is balanced by a spring. This spring is also acted on by a double piston arrangement which serves both as a double-acting cylinder and double-acting pump. Referring to the compensator diagram and circuit, system pressure is applied at port *A* against the valve spool. The valve ports fluid either to port 1 or 2, driving the tandem piston to the right or left.

Continued on page 78

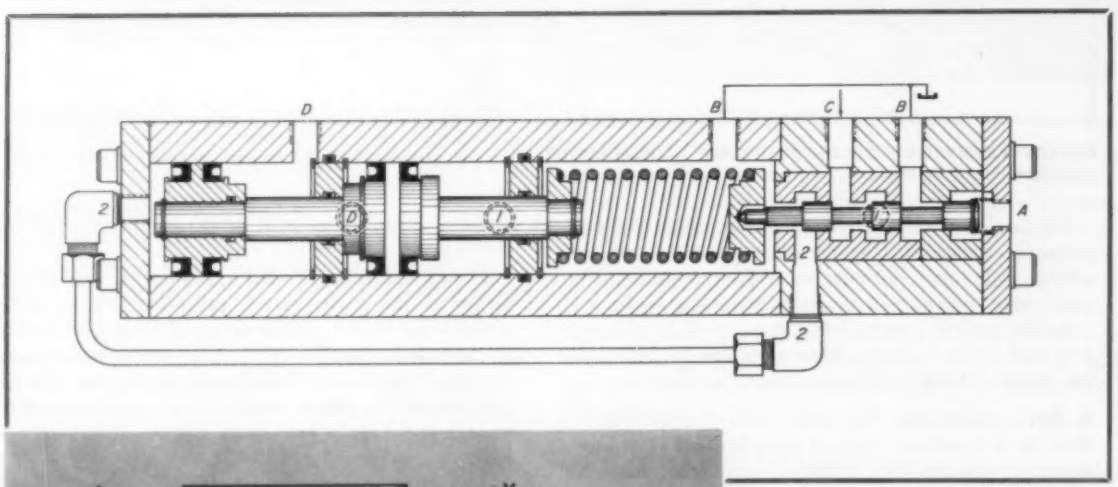
HOW HYDRAULIC DRIVES COMPARED TO ELECTRIC

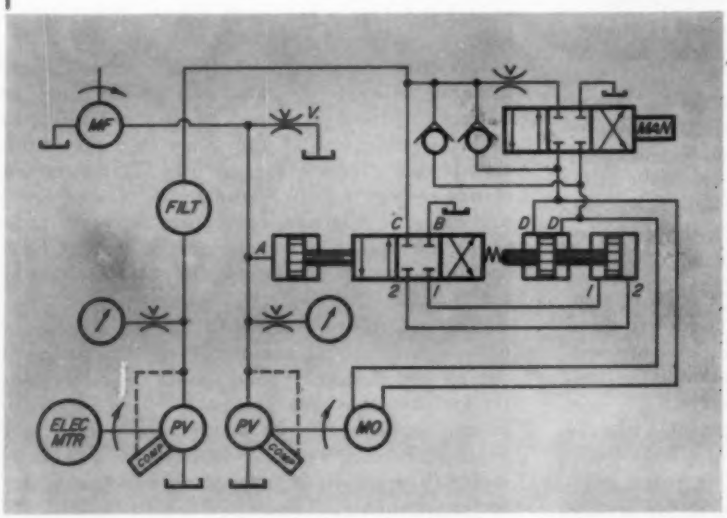
DESIRED CHARACTERISTICS	TYPICAL DRIVES						
	Remote Powered				Direct Mounted		
	Splined Shaft		Universal Joint				
	Electrical Variable Speed	Mechanical Variable Speed	Electrical Variable Speed	Mechanical Variable Speed	Electrical Variable Speed	Mechanical Variable Speed	Hydraulic Variable Speed
COST — Lowest commensurable with other requirements.	Poor	Good	Good	Poor	Good	Poor	Good
STRUCTURAL CONSIDERATIONS							
Practical size	Possible	Possible	Possible	Possible	Poor	Poor	Good
Practical weight	Good	Good	Good	Good	Poor	Poor	Good
Minimum enclosures required	Good	Poor	Poor	Possible	Poor	Possible	Good
MECHANICAL CONSIDERATIONS							
7 hp. continuous power	Good	Good	Good	Good	Good	Good	Good
10 to 1 stepless speed range	Good	Poor	Poor	Good	Poor	Good	Good
Close speed regulation ±4%	Good	Possible	Possible	Good	Possible	Good	Good
Efficiently satisfy minimum band requirements	Poor	Possible	Possible	Poor	Possible	Poor	Good
Provide power for other machine functions	Poor	Good	Good	Poor	Possible	Poor	Good
SERVICE CONSIDERATIONS							
Minimum guards and safety precautions	Good	Poor	Poor	Poor	Poor	Possible	Good
Accessibility of working parts	Good	Good	Good	Good	Poor	Possible	Good
Ease of chip and coolant protection	Poor	Poor	Possible	Possible	Poor	Poor	Good
Utilization of standard components	Good	Good	Good	Good	Good	Good	Good



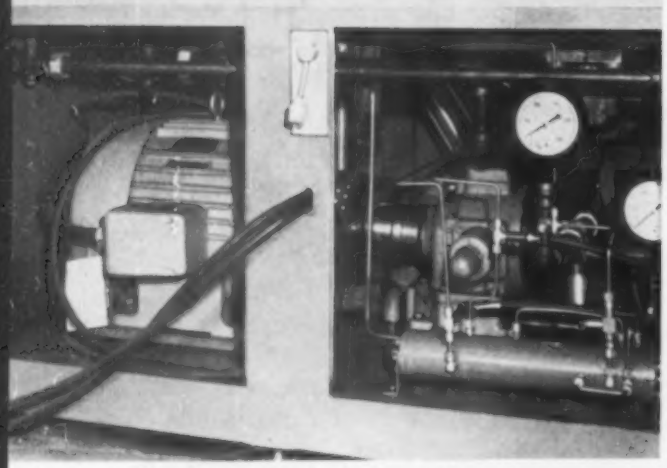
DIRECT COUPLED FLUID MOTOR is the only drive that meets requirements of size, weight, speed range, cost, and servicing.

band speed constant

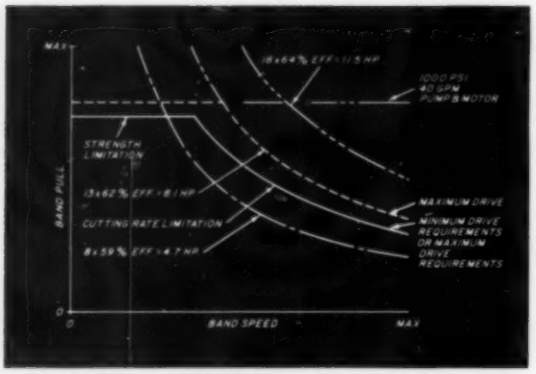




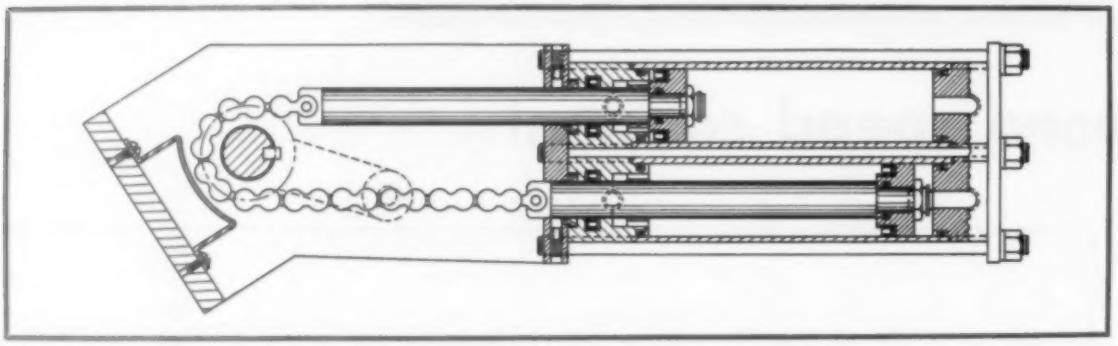
SLIP COMPENSATING SYSTEM positions variable volume pump to larger displacement positions as pressure increases. Four-way valve is balanced at neutral position when force due to system pressure equals spring force.



40-GPM, VARIABLE VOLUME, VANE PUMP supplies band drive. Pressure compensation limits system pressure to 1000 psi. Slip compensator is shown at lower right.



BAND SAW'S PERFORMANCE at low speeds depends on physical strength of band. At higher speeds, electric motor limits cutting rate.



ROTARY ACTUATOR TO CONTROL PUMP DISPLACEMENT must not have backlash, or internal leakage. It must move in proportion to oil supplied.

The tandem piston moves a distance proportional to pressure change, and stops when its force on the spring and valve balances system pressure on the valve, *with the valve in its closed neutral position.*

As the tandem piston moves, it forces fluid into one port and out the other. These ports are connected to the rotary actuator which positions the pump.

• **Drive selection**—The application of a hydrostatic drive to a band saw type of machine tool is unique. Requirements are very different from other machine tools.

Band performance is determined in the low speeds by strength of the band teeth, and a higher speeds by cutting rate. This establishes horsepower and speed parameters.

The table shows how seven drives were compared. The direct mounted, variable speed hydraulic drive is the only one that meets all requirements.

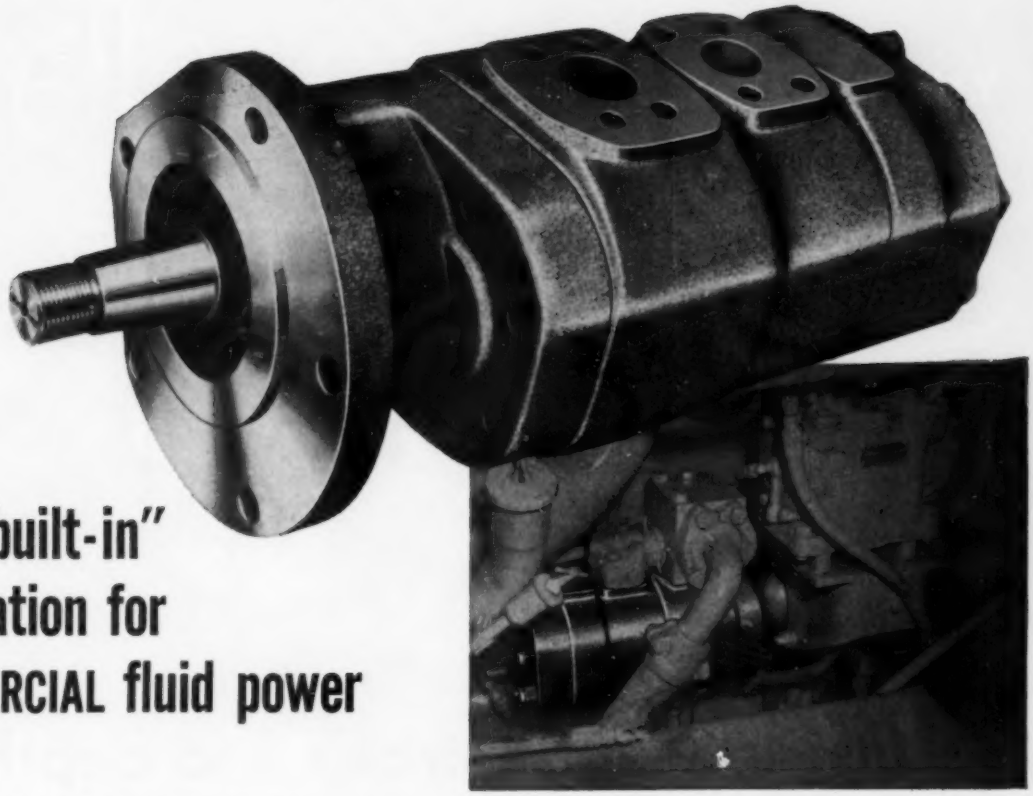
• **Component selection**—To use a standard pump, we selected one with larger capacity and lower speed than necessary: a 40 gpm, 1000 psi, pressure-compensated vane type. Pressure compensation limits pressure and makes a relief valve unnecessary.

In this system, using a fixed displacement, hydraulic motor, band speed is a function of pump volume. Pump pressure depends on resistance to sawing (band pull). *Maximum* band pull is constant at all speeds because pressure is limited to 1000 psi throughout the full volume range.

The requirement for 10:1 speed range, with smooth torque at the lowest speed, ruled out a gear motor because the lowest, *steady* speed of most gear motors is about 400 rpm. The 10:1 speed range would make top speed 4000 rpm which is impractical for this size gear motor. A piston motor would have more than enough speed range but initial cost would be relatively high.

The drive requires 13 hp. Drive system efficiency including hydraulic line loss, gearing efficiency, and efficiency of the hydraulic pump and motor is about 62%. An additional 2 hp for other operations brings electric motor requirement to 15 hp. Maximum drive system characteristic is shown by the dashed line in the curves. If maximum band pull is exceeded at low speed, the fluid motor stalls at 1000 psi. At higher speeds, electric motor horsepower is the limiting factor.

• **Manual pump control**—Band speed is selected on a remote control console. A screw positions the pump's cam ring to set band speed. The rotary actuator for pump positioning must not have backlash or internal leakage. It must move in proportion to oil supplied. Because we could not buy such a device, we designed a simple, double cylinder actuator. It is under pressure at all times to eliminate backlash. ▼▼▼



New "built-in" application for COMMERCIAL fluid power

COMMERCIAL Model H, Series 36 hydraulic pumps were chosen by International Harvester to be the "built-in" original equipment on their new DT-817 engine.

Two pumps — one envelope

COMMERCIAL's Model H pumps, direct tandem mounted on one shaft, do double duty for the Payhaulers generating fluid power for load discharge and power steering. Pump delivery data:

Payhauler	Hoist Pump	Steer Pump
Model 65	58 gpm @ 1500 psi	18.4 gpm @ 1000 psi
Model 95	73 gpm @ 1500 psi	18.4 gpm @ 1000 psi

"95" Payhaulers on the go—Model H pumps under the hood.

"Direct-connect" power hook-up

COMMERCIAL pumps are mounted under the hood on right-hand side of engine, directly below the air compressor. Pump shaft is coupled to the Payhauler's engine crankshaft through its front gear train. Pumps are 5-bolt flange mounted direct to matching flange opening in gear train housing. In the few instances when hydraulic power is not required, a simple cover plate seals the opening. Gained: Clean cut power plant design—logical position simplifies piping, provides easy access for servicing and maintenance, plus better protection for the heart of the fluid power system.

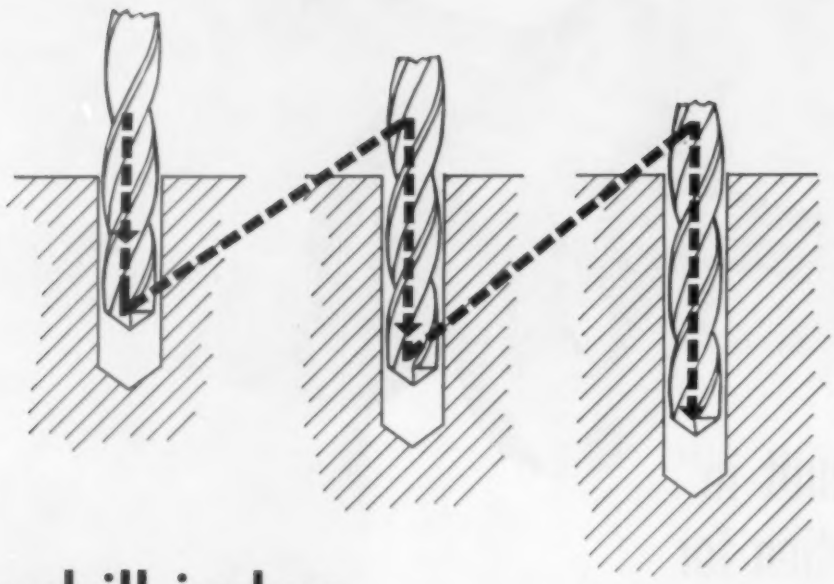
Strict specs and standards met

International Harvester demanded high efficiency, dependable continuous duty performance over long life span. COMMERCIAL's rugged, heavy duty, high performance Model H pumps survived these rigid tests—were easily adaptable to prescribed installation standards. Once again, Model H comes out on top.

Engineering experience available

Personal technical service and assistance on fluid power applications is yours for the asking. Send today for your copy of Bulletin 100-P4. Address inquiries to Commercial Shearing & Stamping Company, Dept. A-23, Youngstown 1, Ohio.

COMMERCIAL
shearing & stamping



Deep drill index adjusts advance stroke and depth

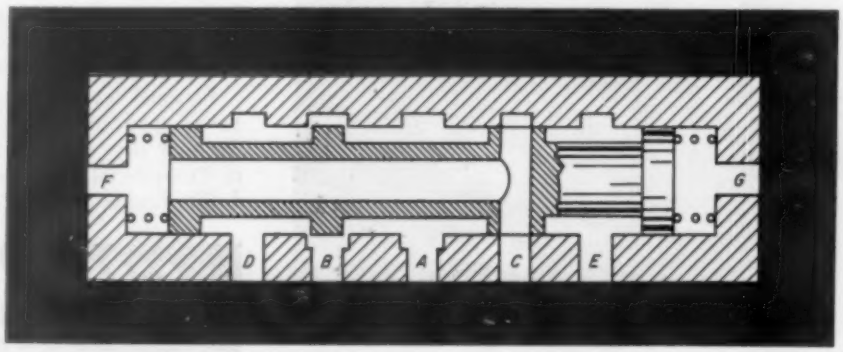
• By J. R. FAWCETT, *Bowdon, England*

TO DRILL a deep hole the drill must retract from the hole many times to flush away chips and allow coolant to enter. For fast cycling, the drill should rapid advance each time to within a few thousandths of an inch of the bottom of the hole.

This twin-head drill circuit meets this requirement with an automatic depth controller.

• **A Depth Controller** mounted on one drill head has two dogs which actuate limit switches for feed and rapid reverse. The relative position between the dogs and the limit switches determines feed point and drilling depth. A cylinder actuated mechanism indexes the depth controller each drilling stroke, so the drill rapid advances farther and so drills deeper each stoke. The INDEX cylinder, which moves with the drill, indexes the depth controller when it extends at the end of each rapid reverse. It rotates a pawl mechanism into the depth controller's ratchet. This slides the depth controller and dogs to the left, so that the drill can

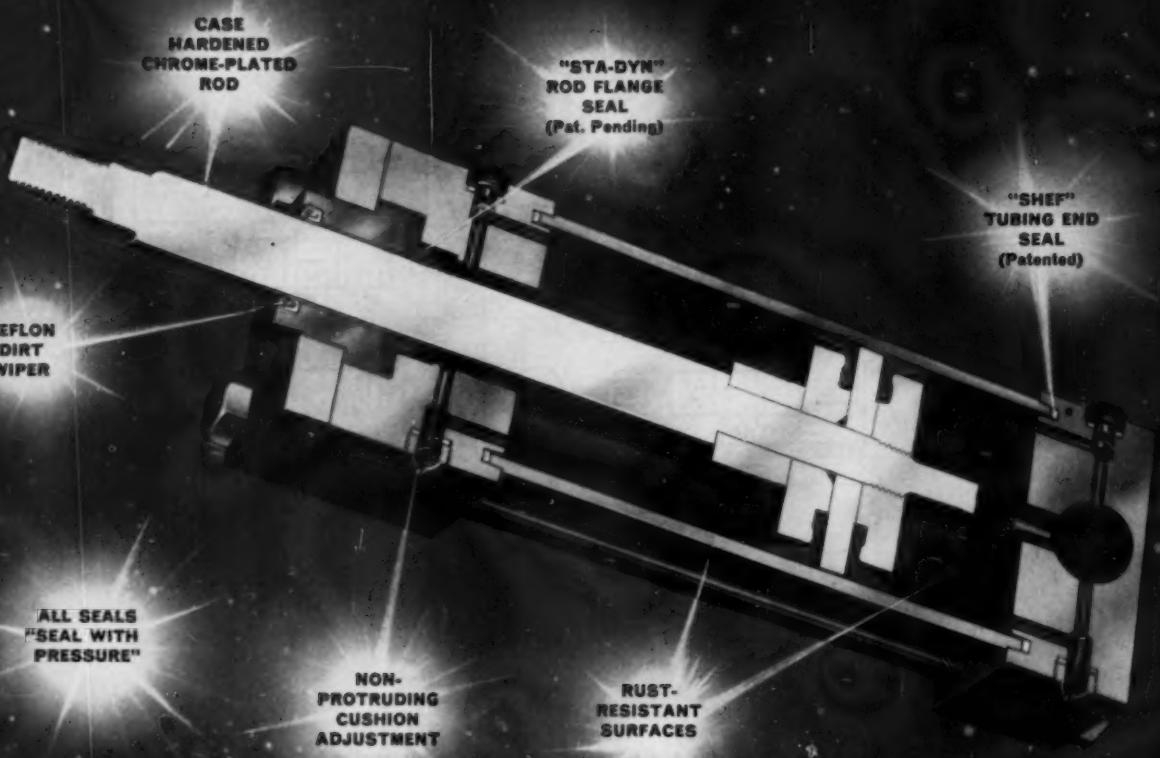
Continued on page 82



HOLLOW SPOOL, directional valves connect the cylinders in series during their stroke, and in parallel to insure they both start together.

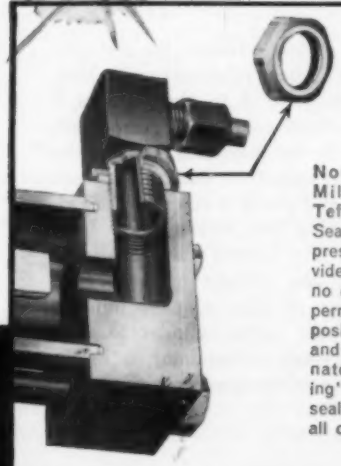
Circle 91 →

Stellar RELIABILITY and ECONOMY


CASE HARDENED CHROME-PLATED ROD
"STA-DYN" ROD FLANGE SEAL (Pat. Pending)
"SHEF" TUBING END SEAL (Patented)
TEFLON DIRT WIPER
ALL SEALS "SEAL WITH PRESSURE"
NON-PROTRUDING CUSHION ADJUSTMENT
RUST-RESISTANT SURFACES

Miller AIR CYLINDERS

PORT SEALS



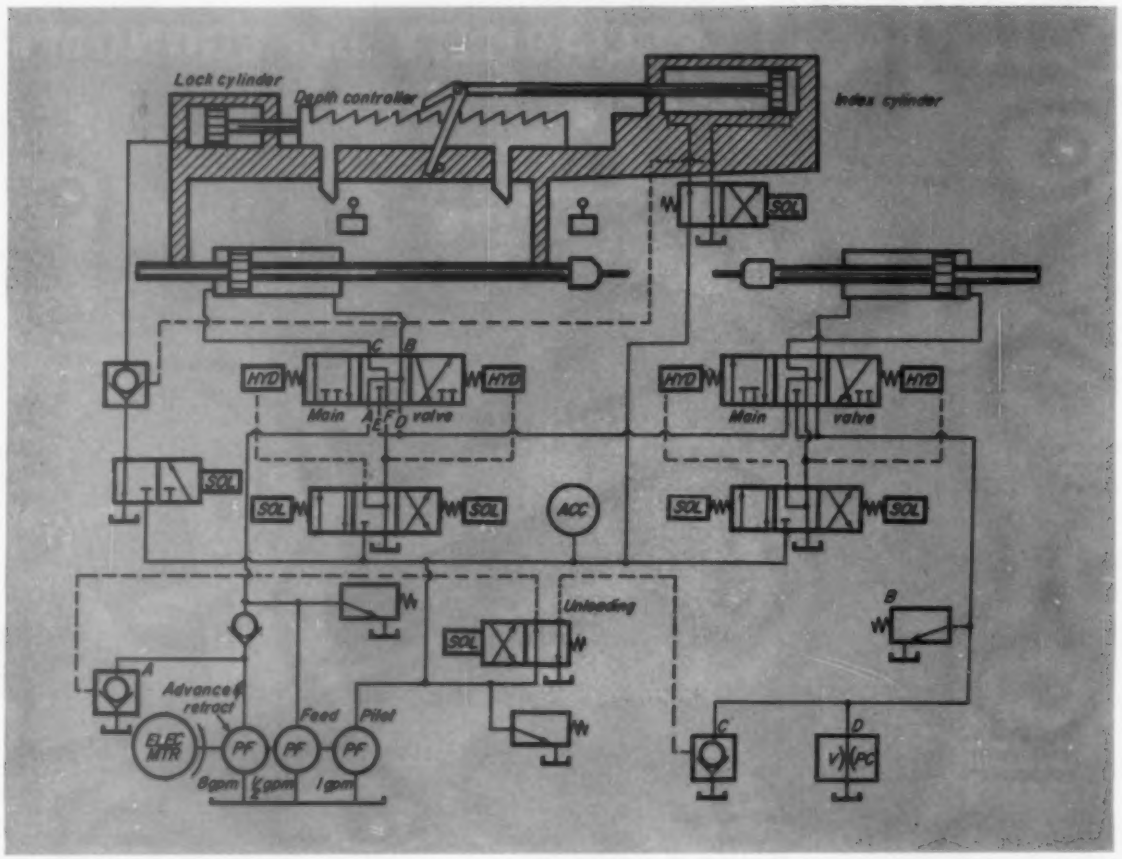
Now—with every Miller Cylinder—Teflon-sealed Port Seals that "Seal with pressure" are provided as standard at no extra cost. They permit much faster positioning of lines and fittings, eliminate "overtightening" damage, and seal perfectly against all operating media.

Here are eight more reasons why Miller Air Cylinders continue to be the most economical and reliable cylinders that money can buy. These stellar features—including the new port seals—are standard Miller construction—yours at no extra cost. Thus, they provide appreciable savings in original investment—*particularly for those who insist on "J. I. C." quality throughout.* Savings in operating costs are even greater, because these features are proven assurance of longer cylinder life, greater efficiency, reduced maintenance and downtime.

Specify "Miller" for greater reliability and economy! Write for bulletin.

MILLER FLUID POWER

7N017 YORK ROAD, BENSENVILLE, ILLINOIS



TWO DRILLING CYLINDERS advance and retract in a series circuit. The depth controller indexes the dogs controlling rapid advance stroke and hole depth, so both increase each cycle.

extend farther into the work before the limit switches are actuated. After feed, the drill rapid retracts until it trips an adjustable limit switch set at a reversal point slightly above the workpiece. Another limit switch determines the hole's final depth.

A locking cylinder which also moves with the drill prevents the depth controller dogs from moving during drilling. When pressure is applied to the INDEX cylinder to extend it, pressure is also applied to a pilot-operated check valve in the LOCK cylinder line. The check valve opens to let the LOCK cylinder retract for the index. At full hole depth, the LOCK cylinder extends to reset the depth controller.

● **Series Synchronizing**—Hollow spool directional valves controlling the drill cylinders connect them in series in both stroke directions. This keeps the cylinders moving together. Any error in synchronizing the cylinders is made up by insuring they both start the drilling stroke together.

With the cylinder valves in neutral and the UNLOADING valve de-energized, pump *1* unloads through pilot-operated check valve *A*, and pump *2* delivers through the cylinder control valves and relief valve *B*. Part of its flow also goes through flow control valve *D*. Pressure created by the relief valve is applied against the inner sides of the cylinder pistons to force them back to starting position before the next forward stroke. The outer sides of the pistons are connected to tank through the pilot section of the valves. Arranging the cylinders in parallel like this at the beginning of each stroke protects against trapped fluid in one cylinder preventing it from retracting fully if the other cylinder retracts first. It also insures a fluid supply from pump *2* to retract each cylinder fully regardless which retracts first.

● **Speed Sequence**—For fast advance, the UNLOADING valve is actuated to open pilot-operated check valve *C* and allow check valve *A* to close. Pump *1* delivers 8 gpm to the drill cylinders during rapid advance and retract only. At the beginning of feed, the UNLOADING valve is de-energized, so pump *1* unloads through check valve *A*, and pump 2 supplies the cylinders with ½ gpm. During feed, exhaust flow from the cylinders is through flow control valve *D*. Pump *3* supplies pilot fluid to the cylinder control valves and pilot-operated checks. It also supplies fluid to the INDEX cylinder and the LOCK cylinder to reset the depth controller. A small accumulator is in the circuit to operate the pilot valves speedily with a small pump. ▼▼▼

IMPERIAL
Engineering and Data File

DURA-TITE TABLE OF COMPARISON

Features	TYPE OF PORT SEAL		
	Pipe Thread	"O" Ring	Dura-Tite
Permits angular positioning of fitting with no possibility of leaking	no	yes	yes
Suitable for use with all hydraulic fluids without changing components	yes	no	yes
Safety from seepage up to 20,000 psi	no	no	yes
Can be reconnected repeatedly without changing sealing element	no	no	yes
Withstands high pressures to temperatures of 300° F	no	no	yes
Simple to install — no loose parts	yes	no	yes
Usable with SAE standard straight thread boss	no	yes	yes
Unlimited shelf life	yes	no	yes
No deterioration of sealing element due to aging	yes	no	yes
No possibility of damaging sealing element in assembly	yes	no	yes

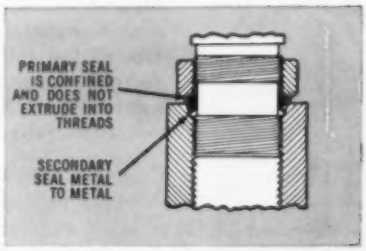
HOLDS PRESSURES TO 20,000 PSI...

NEW DURA-TITE IS INDUSTRY'S MOST FOOLPROOF PORT SEAL FOR TUBE FITTINGS!

From Imperial research comes a new, more effective and far more simplified port sealing method for tube fittings. As you can see on the chart pictured above, Dura-Tite does everything an "O" ring fitting will do—*and much more*—without requiring any special skill or care.

Even at pressures up to 20,000 psi, Dura-Tite provides a positively seepproof seal, and the fitting can be positioned in any direction without impairing tightness. And, because Dura-Tite's polyamide split ring seal is confined, it cannot distort or extrude into threads. The joint can be opened and remade at least 25 times without seepage.

Note how Dura-Tite creates a *double seal* with a single, simple operation. The fitting comes complete, with no additional parts to be added in the field. It uses any standard SAE straight-thread port. No special machining is required.



The special polyamide sealing medium contained in Dura-Tite will outperform any "O" ring compound. It has no hydraulic fluid limitations, being highly resistant to most chemicals. Solves temperature problems, too. Tests have shown that the Dura-Tite seal will withstand high pressures at temperatures up to 300° F. There is no need for periodic replacement because of deterioration on the job.

Dura-Tite port seals can be obtained in both Imperial Hi-Seal flareless and 37° flared tube fittings in steel and stainless steel. And, Dura-Tite costs no more than "O" ring seals but makes important savings in installation.

IT'S IN THE BOOK

Dura-Tite port seals are covered in Imperial's new Hi-Seal catalog No. 3108 and in Bulletin EPR-2. Send for copies today.

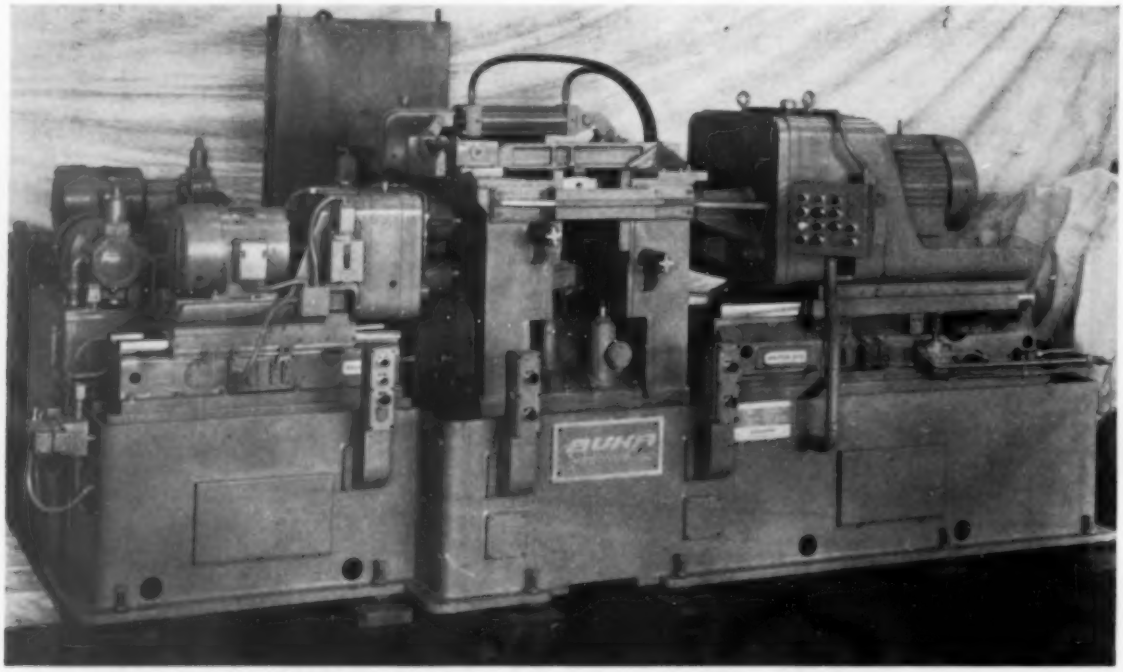
THE IMPERIAL BRASS MANUFACTURING CO.
Dept. AH-60, 6300 West Howard Street
Chicago 48, Illinois

Circle **68** on Time-Saver Card

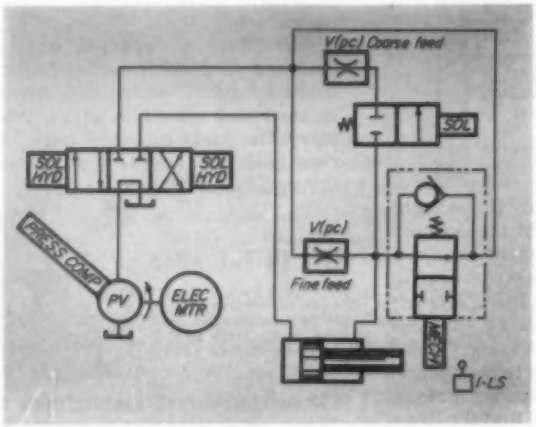
Tool feeds on machine tools must change for drilling, reaming, facing, and boring. With hydraulic cylinders feeding the tools, feed rates can be easily controlled. Here are two machines that use four different methods to control tool feed.

How two machine tool

1 By MICHAEL ZAJAC
Buhr Machine Tool Co., Detroit, Michigan



EACH OF THE THREE TOOL CYLINDERS on this automatic boring machine has its own power unit. Two flow control valves, a spring offset solenoid valve, and a deceleration valve give rapid too approach, coarse feed, and fine feed.



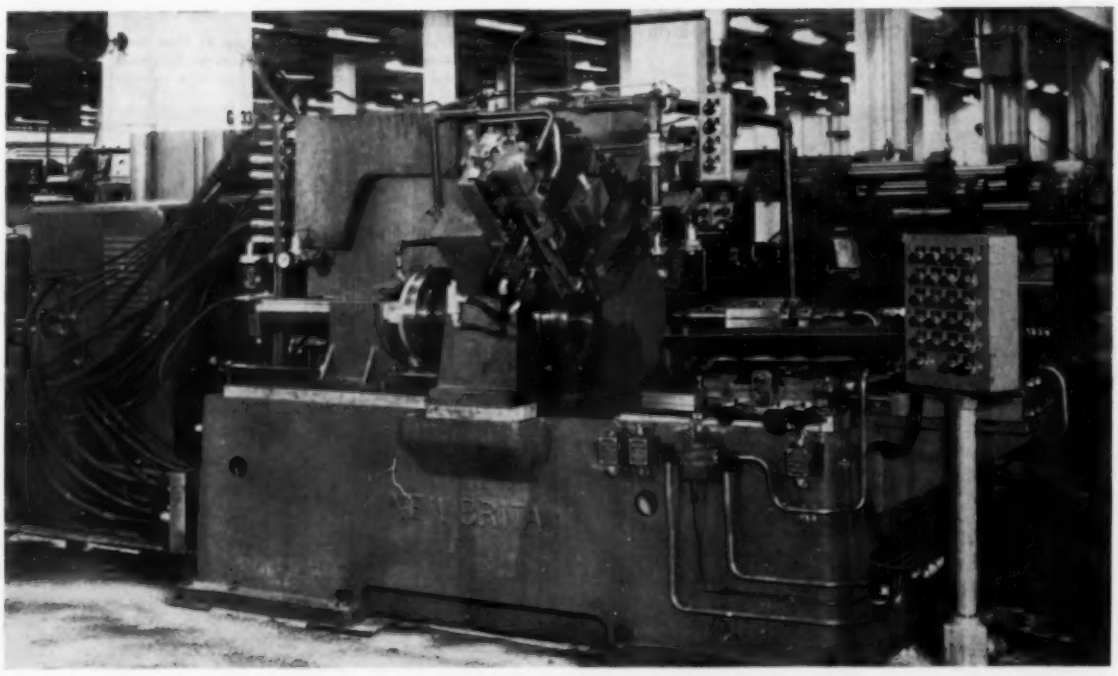
RAPID approach, coarse, and fine feed are accurately controlled on this three station boring machine with a deceleration valve and two parallel connected flow control valves. For rapid approach, oil from the rod end of the cylinder flows through the deceleration valve to tank. A cam, on the way unit, closes a deceleration valve to start coarse feed. During coarse

Continued on page 86

AFTER THE PART is clamped in place, the operator presses a pushbutton. The solenoid, spring offset, valve energizes, the control valve shifts, and the platen extends. Flow from the rod end of the cylinder returns to tank through the deceleration valve. At the START FEED point, a cam closes the deceleration valve, forming oil through both flow control valves. The platen then extends at coarse feed. At the FINE FEED point in the stroke, a limit switch de-energizes the solenoid valve. The valve closes and return oil is forced through the fine feed control valve. A limit switch at the end of the stroke shifts the control valve and returns the platen.

builders control speed

2 By **WILLIAM B. RETZ**, *New Britain-Gridley Machine Div., New Britain, Conn.*,
and **JACQUES CARPENTER**, *Vickers Incorporated., Div. Sperry-Rand Corp., Detroit, Mich.*



LARGE AUTOMATIC LATHE regulates tool feed by using flow control valves in series, cam-actuated flow control valves, and separate pumps and lines for fast approach and feed flows.

THIS automatic lathe chucks the work in the center while both ends are being machined. This insures accurate concentricity between the diameters machined. The lathe is fully automatic. It is electrically controlled and hydraulically powered. Since the tools feed hydraulically, no cams or gears need be changed to vary feed rates.

• **Separate feed lines**—Two hydraulic lines supply the tool cylinders; a ¾-inch line for fast approach and a ¼-inch line for tool feed. The ¼-inch line is kept at a constant pressure of 750 psi.

A hi-lo pump supplies hydraulic power for the machine. The large volume pump delivers to the ¾-inch line, and the small volume pump to the ¼-inch line. Flow through the ¾-inch line extends the cylinders fast. Flow through the ¼-inch line gives machining speed, and supplies the cylinders through sequence valves when pressure rises.

• **Flow control valves in series**—To get two controlled feed rates on the forming cylinder, flow from the rod end passes through two flow control valves in series. This arrangement assures a smooth transition from fast feed to fine feed while the tool is still in the work. The valve with the smaller orifice is bypassed during fast feed.

The DRILL-REAM cylinder has two drilling speeds and one reaming speed. A 3-way valve in the line from the rod end of the cylinder directs the flow through either the REAM or the DRILL flow control valves after the cylinder has closed its deceleration valve.

A shuttle cylinder moves the drill and ream carriage back and forth. A deceleration valve slows the carriage to a stop at the end of its stroke. A small orifice drilled in the valve body bypasses the check valve,

Continued on page 86

HOW TWO MACHINE TOOL MANUFACTURERS

1 Continued

feed, speed is governed by two flow control valves in parallel. When the machine calls for fine feed, a limit switch shifts the solenoid valve, blocking flow through the coarse feed flow control valve. Fine feed is controlled by adjusting the fine feed control valve. ▼▼▼

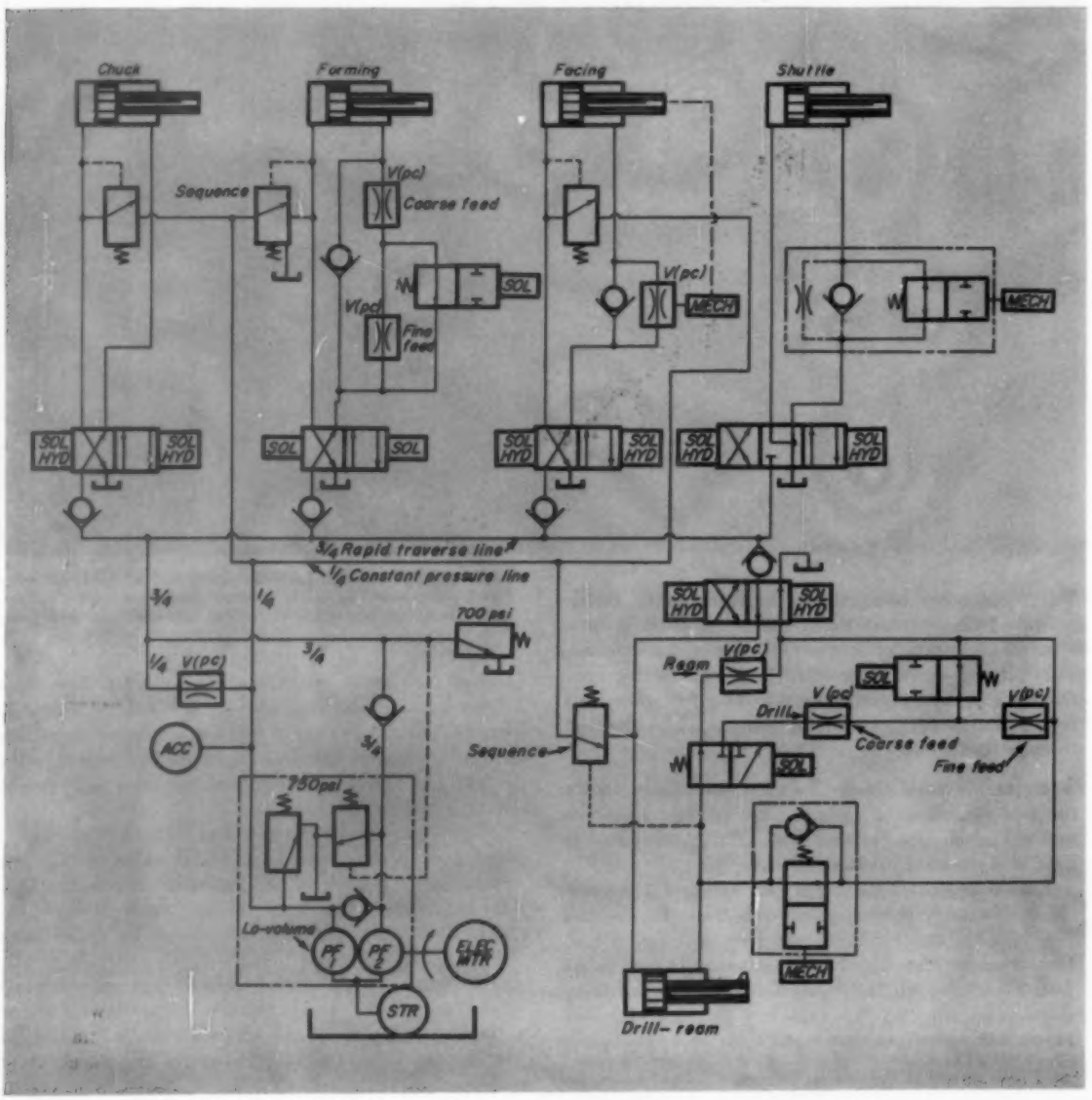
2 Continued

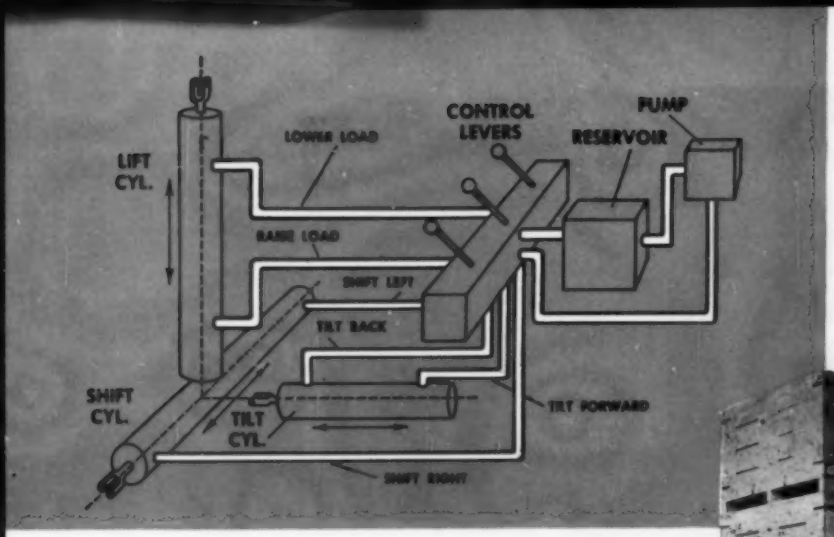
and insures that the carriage is held against its stop by system pressure.

• **Cam-actuated flow control valve**—To keep the surface speed constant at the facing tool, spindle speed increases as the tool moves it. A modified, variable flow control valve maintains a constant ratio between spindle speed and tool feed so that feed per revolution also remains constant. A plunger, built into the valve body, changes flow rate as the cylinder moves in and out. A cam attached to the facing tool slide moves the valve plunger. ▼▼▼

THE ¼-INCH LINE to the cylinders is held at a constant pressure of 750 psi by the low-volume pump. This line feeds the cylinders while the large-volume pump is unloaded or while any of the other cylinders are rapid traversing. A small accumulator in the low volume pump circuit absorbs any surge pressures during machining.

The DRILL-REAM cylinder extends at four speeds: rapid traverse, coarse drill, fine drill, and ream. Solenoid valves select flow control valves to meter fluid from the cylinder's rod end.





Schematic drawing of hydraulic system in Blackwelder Fork Lifts, built for every farm material-handling operation. White lines indicate Gates Hose for hydraulic fluid operating lift, tilt and shift cylinders.

Gates Hose helps Blackwelder Fork Lift

lower costs...pick up profits!

"We've been using Gates wire-reinforced hydraulic hoses on our Blackwelder Tractor-mounted Fork Lifts for years," says Fred Hill, Chief Engineer for the Blackwelder Manufacturing Company, of Rio Vista, California, makers of farm material handling equipment. "Their exterior cover and durable inner tube make them ideally suited to withstand the rough abrasion and temperature conditions under which our equipment is operated. We know our hydraulic components will function properly with Gates Hose assemblies, and our customers benefit by keeping maintenance to an absolute minimum!"

Immediately available in all major markets

Gates Hydraulic Hose — built to meet or exceed SAE specifications — is available nation-wide in wire-braided and horizontal-braided construction in a complete range of sizes, for medium-pressure or high-pressure use. Ask your nearby Gates Distributor, for Gates Hydraulic Hose Assemblies booklet, IH 43.

The Gates Rubber Co., Denver, Colorado
Gates Rubber of Canada Ltd., Brantford, Ont.

TPA 466

Gates

The Mark of *Specialized* Research

Gates Hydraulic Hose / Made in a Full Range of Sizes Medium-Pressure, High-Pressure

Circle **50** on Time-Saver Card

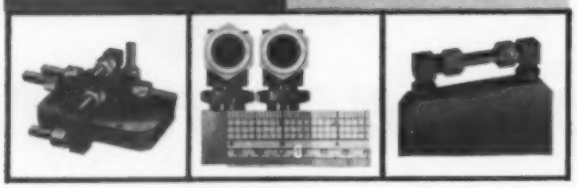
FLODAR

SELF-SEAT

STRAIGHT THREAD PORT FITTING

5 exclusive features

- Metal-to-metal seal eliminates "O"-ring
- Eliminates fluid system leakage
- No swing radius required
- No special seat preparation required
- Elbows and Tees can be positioned accurately



The FLODAR ***SELF-SEAT*** port fitting consists of a stem and body with a floating nut. Tightening the nut forces the stem into the seat making a leakproof, metal-to-metal seal.

The fitting body does not turn. Thus, fittings can be positioned close together — ⅛" fittings on 1" centers. Straight runs can be bench assembled.

SPECIFICATIONS

FLODAR ***SELF-SEAT*** fittings are available in sizes from ⅛" to 2" in steel, aluminum, brass, and stainless steel. All popular shapes are available.

J. I. C. STANDARD

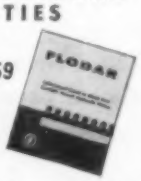
EASY TO INSTALL

To install, simply drill a pilot hole. Form the sealing step with an inexpensive drill or counterbore. Tap for a standard straight thread and tighten with a standard wrench.

CAN BE ADAPTED TO EXISTING PIPE THREADS

FAST DELIVERY FROM STOCKS IN ALL MAJOR CITIES

WRITE FOR FLODAR SELF-SEAT CATALOG M-59



Fittings Protected by U.S. and Foreign Patents. Other Patents Pending.

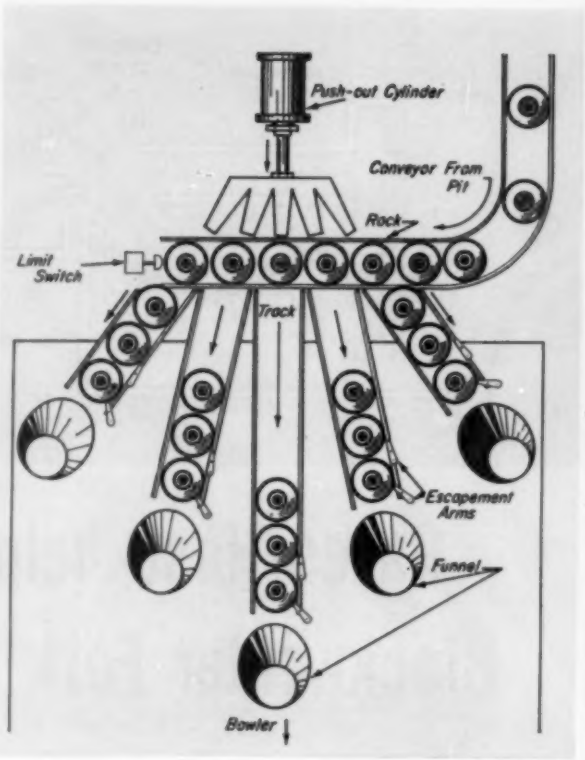
Copyright Flodar Corp. 1960

FLODAR Corp.

16911 ST. CLAIR AVE. • CLEVELAND 10, OHIO

Pioneers in The Development Of Leakproof Fluid Systems

Circle **42** on Time-Saver Card



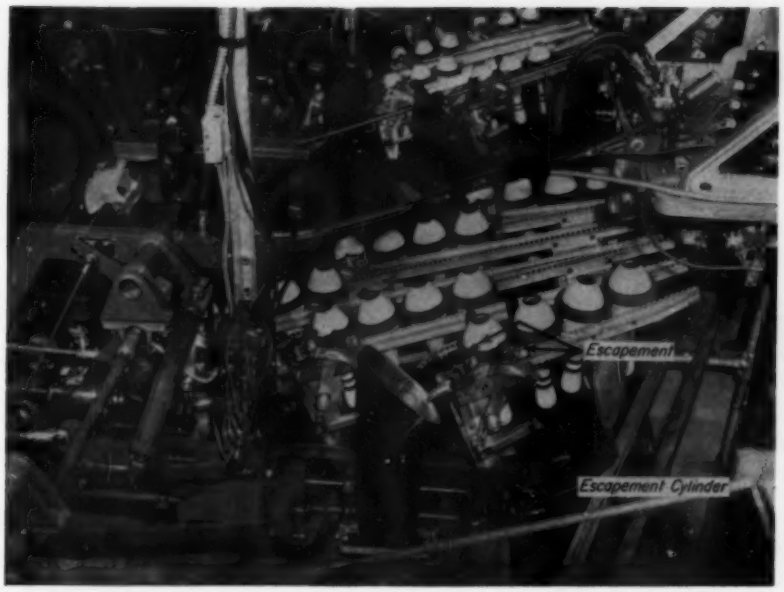
PINS MOVE ON A CONVEYOR to the rack where they nudge each other along. The push-out cylinder transfers one pin to each of five tracks. Pins ride down the track on their rubber "belly" bands, which make the pins the same diameter as the ball and cause friction when handling the pins. It complicates separation of the ball from the pins.

Pneumatic

• By **ANDREW M. DAMER,** *John*

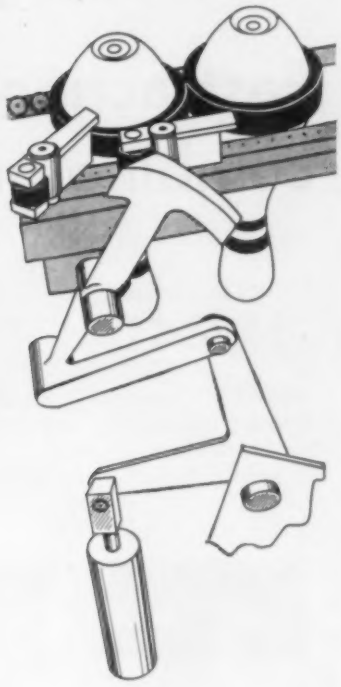
THE BOWLER controls the pinspotter with two pushbuttons. They actuate two stepping swiches which sequence operations. The bowler sets up for his first roll by pressing the SET-UP button. Pins remaining from the previous bowler are swept away and a new frame is set up. Pressing the PICK-UP button readies the lane for the second roll. This starts a mechanism which picks up the live pins, sweeps away the deadwood, and then replaces the live pins.

• **Escapement releases pin**—Engineers from Philips Electronics Industries, who developed the pinspotter, assisted on the pneumatic circuits by John Spot-



EACH FUNNEL on the set up plate is immediately above the position on the deck on which the pin is to be set. The plate holds and deposits five pins on the lane when the bowler presses the set-up button. Twenty pins are used by each pinspotter, which is the first automatic machine developed for five-pin bowling. One machine to each lane.

THE ESCAPEMENT CYLINDER is controlled by a 4-way, 2-position, single solenoid valve. When the bowler presses the set-up pushbutton, the double-stop escapement is withdrawn. Though there may be several pins in a track, only one is allowed to enter each funnel.



Canadian bowlers prefer five-pin bowling and are having more fun with pneumatic pin-spotting equipment designed for this game.

escapement feeds bowling pins

Spotton Co., Ltd., Toronto, Ontario

ton Co., Toronto, worked out a pneumatically-actuated escapement that feeds one pin at a time into a funnel on a set-up plate. This plate is raised and lowered, picking up live pins between rolls, and setting up for a new frame.

The three-piece mechanism has two pivoting arms and a swinging release lever. In its inactive position, the leading, pivoting arm *A* prevents pin *1* from entering the funnel. The release lever holds arm *B* parallel to the track. Each arm is spring-loaded. When the escapement cylinder extends, the lever moves from arm *B* to arm *A*. This allows *B* to pivot into the track and prevent pin *2* from moving. The lever pivots *A* parallel to the track and holds it there so pin *1* slides off the track into the funnel. The pin turns right-side-up as it enters the funnel. When the escapement cylinder retracts, the lever swings back to *B*, allowing arm *A* to pivot into the track ready to stop pin *2* when it arrives. The lever pivots arm *B* parallel to the track again, allowing pin *2* to slide down to leading arm *A*. The remaining pins slide down the track to fill the gap. ▼▼▼

PROBLEMS & ANSWERS

● By ELMER F. HEISER, *Precision Products, Inc., Cleveland Ohio*

Fast acting air, high force oil combine on press

PROBLEM—*Design a fast, short-stroke hydraulic press with uniform pressure distribution over the platen area of 84 in. x 9 in.*

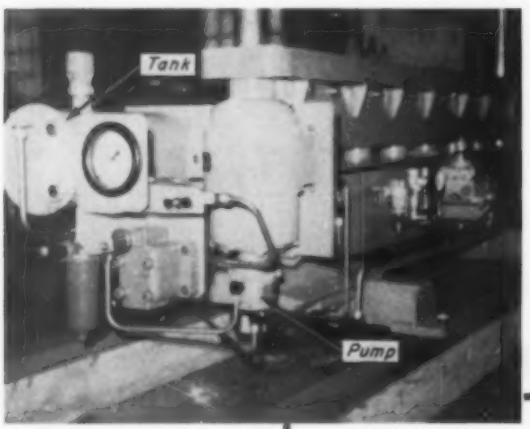
ANSWER—Conventional presses of this long span type for splicing tire cord webs have a cylinder at each end. The upper and lower platens are designed to resist deflection. If the structural members of the press are not adequately sized, there are pressure variations across the platen under load.

To assure uniform pressures, without adding weight or bulk to the press, we mounted six hydraulic rams equally spaced under the lower platen. They exert high upward force for the work stroke. The press is rapidly opened and closed by double-acting air cylinders at each end. This simplifies the hydraulic system and press structure.

On the closing stroke, a 4-way valve actuates the two air cylinders and simultaneously starts the pump. Oil flows into the six rams from the reservoir through the check valve while the hydraulic pump is running. Pressure in the six rams builds up to the relief valve setting when resistance is met and a timer holds it as long as required.

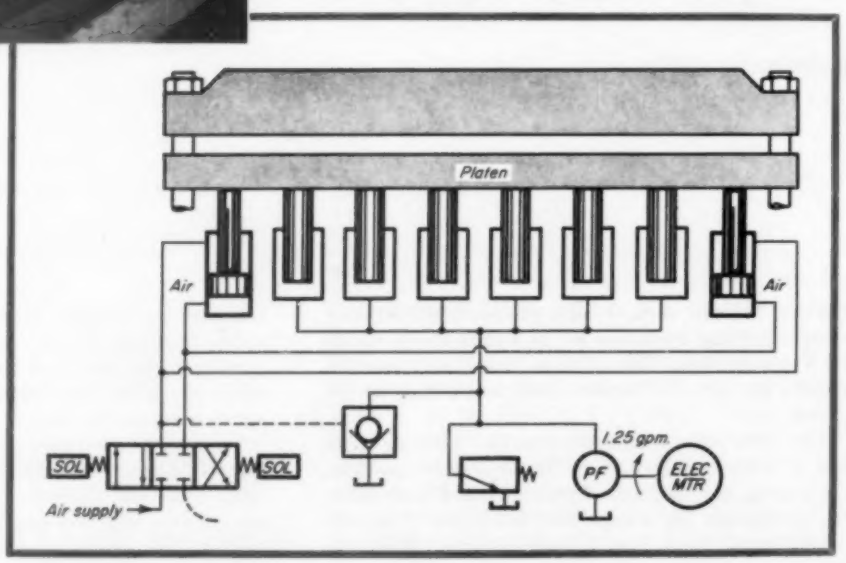
To open the press, the 4-way valve is reversed, and the air cylinders pull the platen back to its open position. Pilot air opens the pilot check allowing oil in the rams to return to tank.

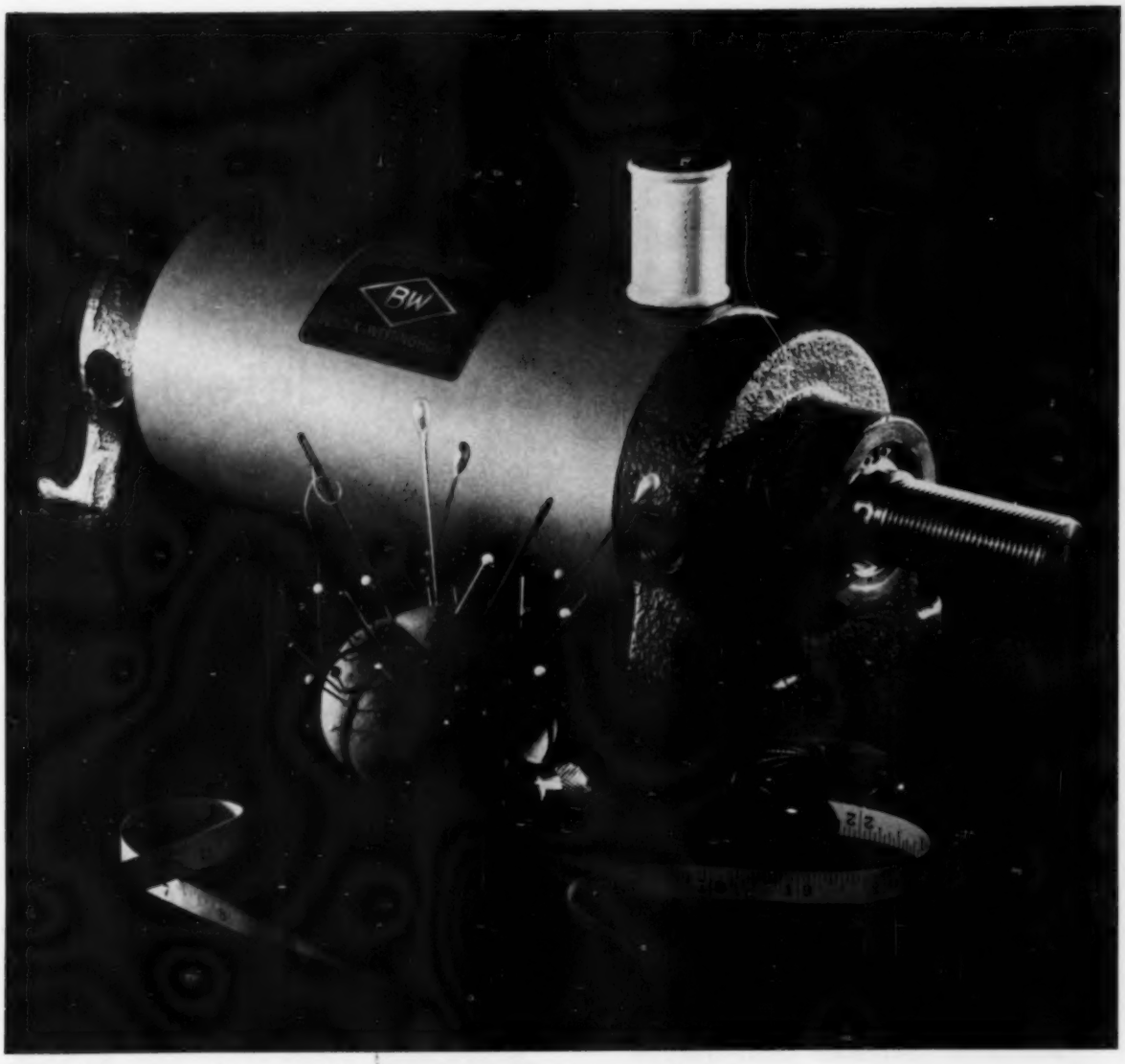
All hydraulic and air controls are housed at the base of the machine. With the rams mounted on close centers, a reasonable deflection of the upper press member can be followed by lower platen deflection, to get uniform pressure over the full platen area. ▼▼▼



PRESS TRAVELS 4½ in. in 1½ to 2 seconds. 40 tons of evenly distributed force is applied for 15 to 20 seconds for plastic splicing of tire cord as it comes from the roll. Cycle is repeated every 20 to 40 minutes.

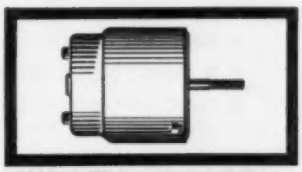
AIR CYLINDERS OPEN AND CLOSE PRESS fast. They permit using single acting rams for high force. Small pump is started when press is closed.



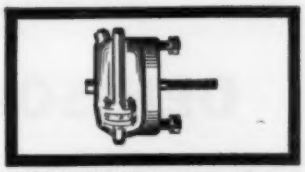


Tailored to fit your needs... Bendix-Westinghouse Power Cylinders

You get made-to-your-measure, top-performing fluid power controls when you specify Bendix-Westinghouse Power Cylinders. Whatever your job requirements, our design and application experience in every field of industry enables us to deliver power cylinders exactly tailored to your needs. Bendix-Westinghouse piston-type cylinders operate up to 200 psi air and 1800 psi oil. Furthermore, our comprehensive inventory of machined parts and our manufacturing flexibility enable us to provide fast delivery of standard units as well as many specialized sizes and mounts. Write today for complete information on the quality advantages you enjoy with power cylinders designed and manufactured by Bendix-Westinghouse.



ROTOCHAMBER has neoprene diaphragm, delivers from 900 to 5000 pounds force at 100 psi air pressure.



ROBOTAIR CHAMBER has optional rubber or neoprene diaphragm, delivers from 300 to 3600 pounds force at 100 psi air pressure.

Bendix-Westinghouse BW

INDUSTRIAL PRODUCTS

Bendix-Westinghouse Automotive Air Brake Company, Elyria, Ohio

One word explains the popularity of these switches...

Dependability!

Denison LOXSWITCH Limit Switches operate with the dependability of Old Faithful. Oil- and dust-tight features, superior electrical characteristics and mechanical design result in three to five times longer life than comparable switches.

L100W HEAVY DUTY LIMIT SWITCH

- 45 CIRCUIT ARRANGEMENTS.
- LONGEST CONTACT LIFE due to lowest impact of 2.5 grams and minimum "bounce".
- WATER-, DUST- AND OIL-TIGHT, NEMA 12.
- ONLY FOUR MOVING PARTS. Longer life, easier to maintain.
- 70° SAFETY OVERTRAVEL without use of extra springs or cams.
- OVER 150 LEVER STYLES.

MODEL M PRECISION LIMIT SWITCH

- LONG MECHANICAL LIFE nylon latch mechanism.
- 600 VOLT INDUSTRIAL CONTROL RATING.
- COMPLETELY ISOLATED CIRCUITS.
- 6° TRIP DIFFERENTIAL, 50° overtravel in both directions.
- PRECISION REPEATABILITY ± .001".
- WATER-, OIL-, DUST-TIGHT – NEMA 12.
- FULLY INTERCHANGEABLE with thousands of existing layouts.

BOTH MODELS AVAILABLE WITH PLUG-IN CONVENIENCE

Write for literature describing our complete line.

Address R. B. DENISON MFG. CO., 386 Broadway, Bedford, Ohio

DENISON LOXSWITCH ®

*Wire with **LOXSWITCH** and you wire for good!*

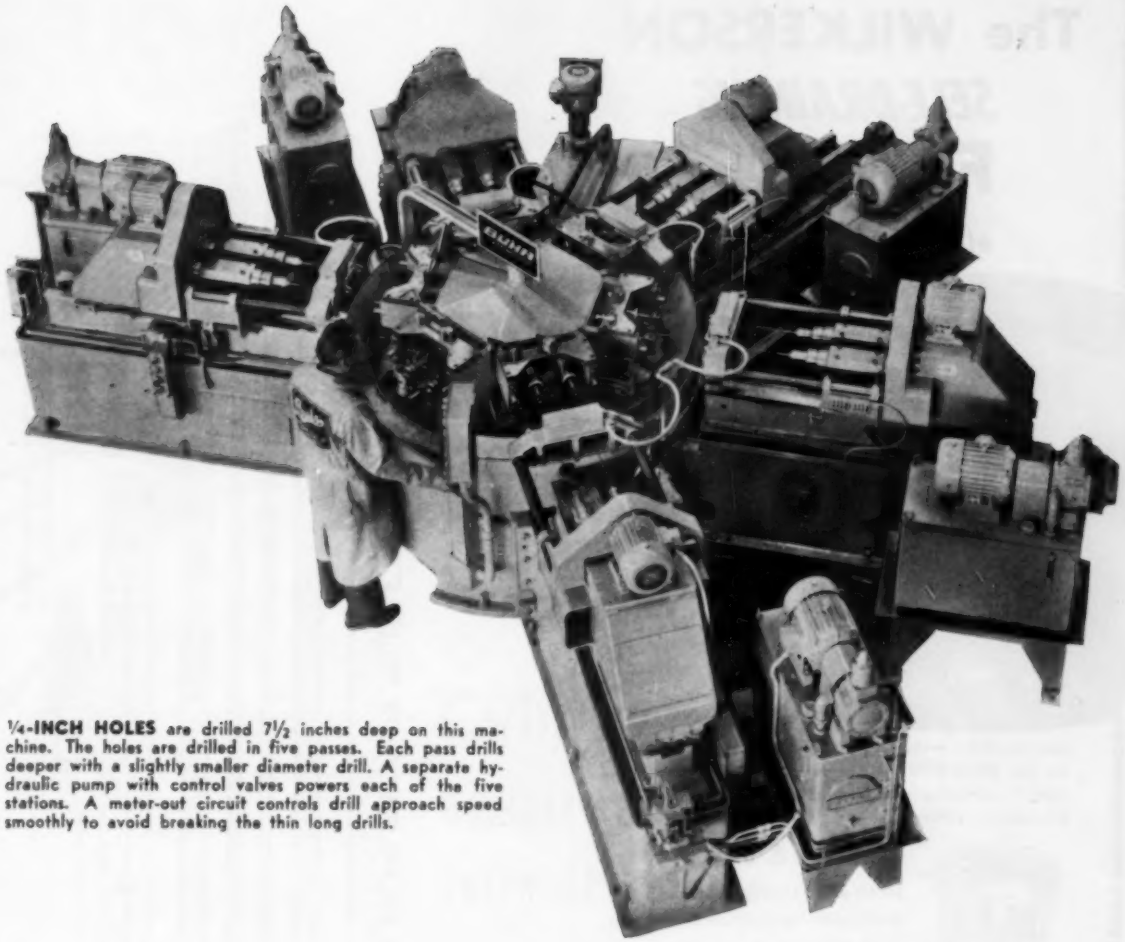
Circle **37** on Time-Saver Card

Proximity detector checks drill breakage

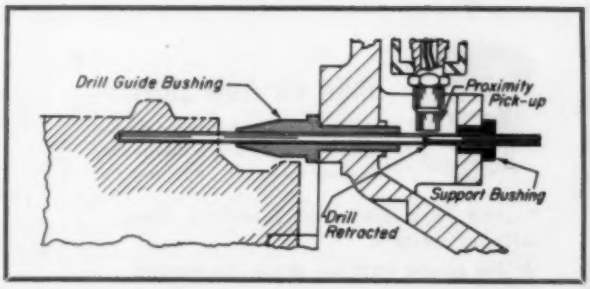
● By **MICHAEL ZAJAC,**
Buhr Machine Tool Co., Ann Arbor, Michigan

PROBING holes for broken drills usually requires a complex hydraulic and electrical control circuit. This machine avoids this by continuously checking for broken drills without using probes. A proximity detector head is installed between the two drill guide bushings. When the drill is fully retracted, its point stops under the detector head.

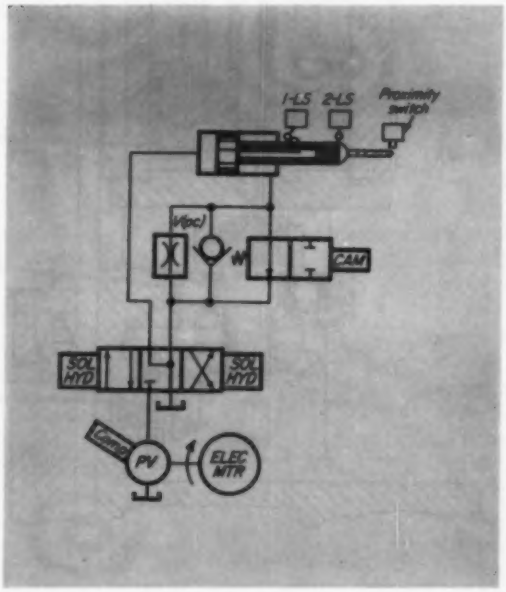
A detector in the proximity pickup head consists of a coil that oscillates when no metal is in its field. This oscillation de-energizes a control relay. As long as there is metal (the drill) in the detector field, the relay remains energized. If the drill breaks, the coil oscillates and de-energizes the control relay. This shuts down the machine and lights a red light indicating a broken drill. ▼▼▼



¼-INCH HOLES are drilled 7½ inches deep on this machine. The holes are drilled in five passes. Each pass drills deeper with a slightly smaller diameter drill. A separate hydraulic pump with control valves powers each of the five stations. A meter-out circuit controls drill approach speed smoothly to avoid breaking the thin long drills.



BROKEN DRILLS are detected without probing the holes. When the drill retracts, its tip rests under a Hartley oscillator coil in the pick-up unit. If a drill breaks it causes the coil to oscillate. The oscillation de-energizes a control relay that shuts down the machine and lights an indicator light.



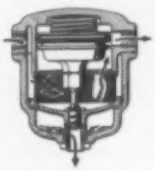
VARIABLE-VOLUME PUMP is pressure-compensated to reduce power. Interlocking limit switch 1-LS actuates when the cylinder retracts fully. It prevents indexing the machine until tools are clear of the work. A depth limit switch 2-LS actuates when the cylinder extends fully. It shifts the control valve to retract the drill. A cam-operated deceleration valve shifts the cylinder from rapid approach to slow tool feed. A pressure-compensated flow control valve governs feed rate.

The WILKERSON *SELF-DRAINING* FILTER

eliminates human failure!

The WILK-O-MATIC will cycle over 3 million times without failure

Leading OEM manufacturers and maintenance engineers use the **WILK-O-MATIC** to extend life of machines and tools by removing moisture and contaminants from compressed air, automatically.



WHEN AIR IS USED,

piston automatically opens sump drain valve. No moisture accumulates, which eliminates danger of water re-entering air stream.

WHEN AIR FLOW STOPS,

moisture collected in upper chamber drops to sump—unit is then ready to drain itself.

Tested to cycle over 3 million times without failure

- ★ No plastic bowl nor drain line needed
- ★ Lowest price
- ★ Requires less space than manual types
- ★ 10-250 PSI with up to 55 CFM
- ★ ¼" to ½" P.T. sizes
- ★ Filters out all water and dirt as small as 5 microns

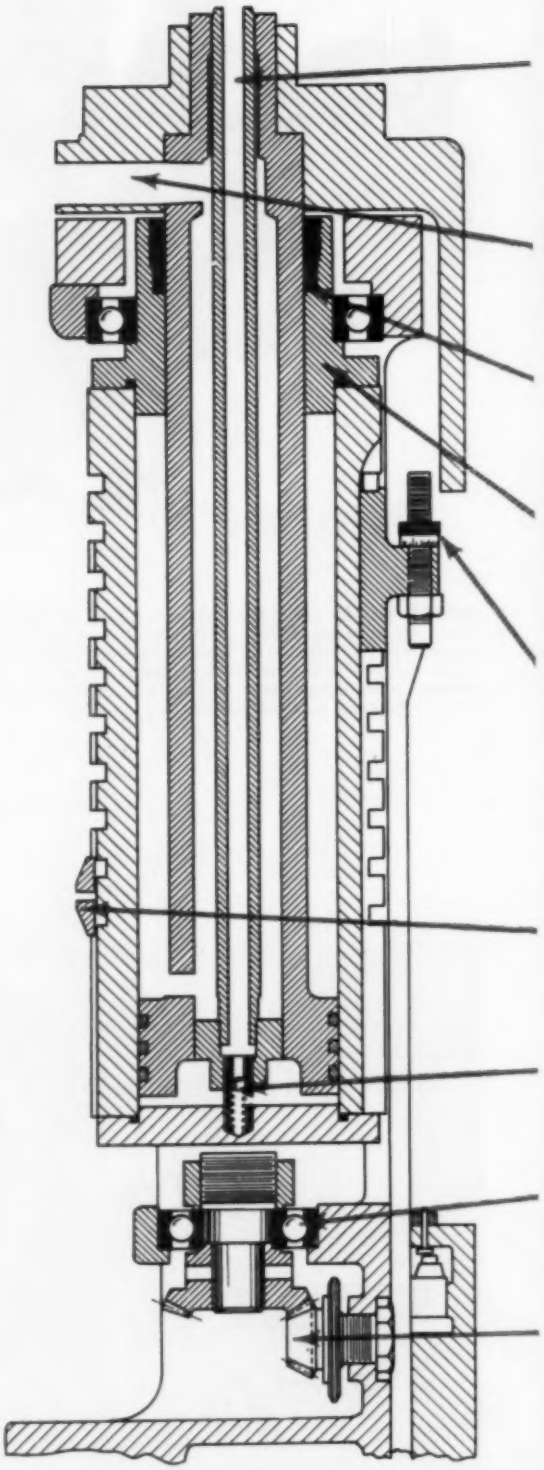
WRITE for Wilkerson circular #1024 for full information on the "Wilk-O-Matic." If threesome and twosome information is desired ask for circular #1026.

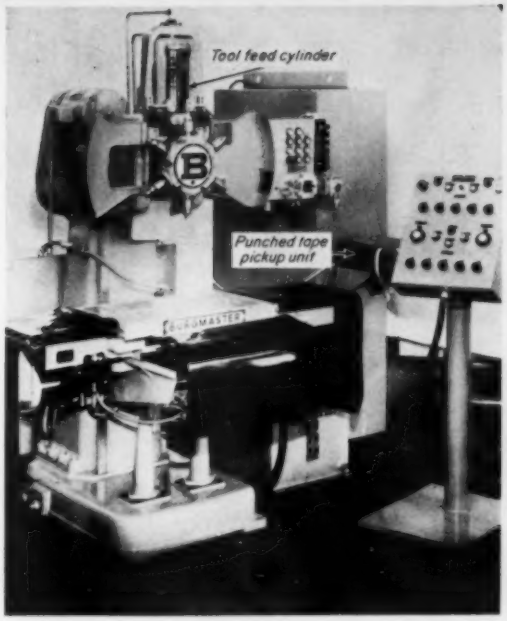
WILKERSON CORPORATION

1643 W. GIRARD ENGLEWOOD, COLORADO

Dedicated to keeping the NEW in pNEUmatics

Circle **139** on Time-Saver Card





TOOL FEED CYLINDER on this rotary turret drill indexes each time the turret indexes. This lines up cams on the cylinder barrel with limit switches and depth stops mounted on the machine.

PUMP FLOW ENTERS through the port on top and passes through the stationary, hollow tube mounted inside the piston rod. It flows out under the piston to extend the cylinder barrel. The piston rod and tube remain stationary.

TO RETRACT THE CYLINDER, pump flow enters this port and passes through the opening between the OD of the tube and ID of the hollow piston rod. It then flows through the port in the bottom of the piston rod to retract the cylinder barrel.

PISTON ROD SEAL

CYLINDER BARREL is mounted in ball bearings so it can turn to its next station when the machine indexes. It has vertical grooves that hold adjustable cams which line up with limit switches when the barrel indexes. One cam determines the point where the cylinder slows down to feed the tool, and the other signals for rapid return.

ADJUSTABLE MICROMETER STOP. There is one of these stops for each work spindle.

CAM TRIPS A LIMIT SWITCH at the end of the work stroke. The switch shifts a 4-way valve and returns the cylinder.

CUSHION CHECK VALVE traps oil under the piston when it retracts, and eases it to a stop.

LOWER CYLINDER BEARING

BEVEL GEARS rotate the cylinder barrel each time the machine indexes. The gears are driven by a shaft from the machine's gear box.

Cylinder design sequences turret drill

• By **J. L. BERG,** *Vice President, Burg Tool Manufacturing Co., Gardena, Calif.*

A SPECIAL design hydraulic cylinder feeds the tools on this 6-spindle, turret, drilling and tapping machine. A punched tape controls work table position in two axes and sequences the machine's operations.

A hi-lo pump circuit supplies hyraulic power for tool feed. Feed rates are controlled by a variable, pressure and temperature compensated flow control valve.

• **Feed cylinder construction**—The hydraulic cylinder feeding the turret also serves as a control drum to mount adjustable micrometer depth stops for each spindle. Cams that control rapid traverse and spindle reverse mount in slots on the cylinder. Bevel gears, connected to the machine's main gear box index the cylinder each time the machine indexes. This rotational indexing lines up cams on the cylinder with stationary limit switches.

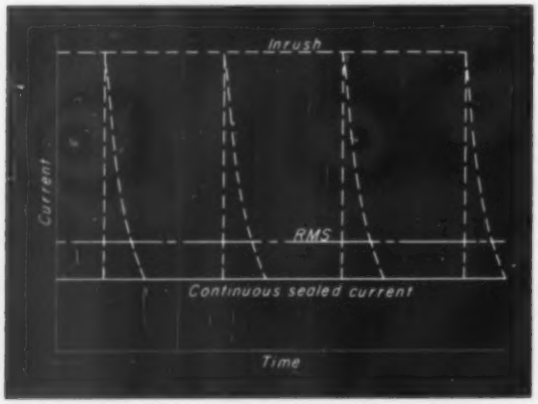
The piston rod is secured to a yoke on top of the machine. The cylinder body extends and retracts the tools. Oil flows through a tube mounted in the cylinder's hollow piston rod to extend the cylinder. Oil to retract the cylinder flows into the area around the hollow tube. ▼▼▼

Why solenoids burn out

• By D. FITZPATRICK, *Engineering Department, Allen-Bradley Co., Milwaukee, Wisconsin*

THE RECORDS of plant maintenance men show there are a good many everyday troubles with the electrical control of hydraulic and pneumatic drives. The records also show that the troubles are usually not the fault of the maker. Usually the causes are misapplication, tampering, lack of maintenance. Whatever the cause, anything that reduces malfunctions will be worthwhile. These are the malfunctions most often brought to the attention of the control manufacturers, and the commonest causes:

• **Solenoid burnout**—Valve solenoids burn out mainly for three reasons. The first is excessive duty cycle. A-c valve solenoids have, in common with all variable air gap a-c devices, inrush currents higher than their seal currents. This often overlooked fact means that a valve solenoid rated for *continuous* duty may not be suitable for highly repetitive *intermittent* duty. If a solenoid is energized very frequently, the rms current in it will be higher than its continuous rms rated current, by an amount which depends entirely on the ratio of inrush to seal currents.



INRUSH CURRENT OF AN A-C SOLENOID may be 5 or 6 times continuous current. Rapid cycling makes rms current higher than continuous sealed current.

Some solenoids must take inrush currents not much more than twice the seal values, while others must take as much as 10 or 12 times. The manufacturer is the only one who can tell the user just how frequently the solenoid may be energized and de-energized without overheating. There is just no other way to find out, except by testing the solenoid to see how much it can take without burning up. D-c valve solenoids are not limited in this way. The sensible solution is to ask the manufacturer of the valve.

SOLENOIDS OF A 2-POSITION VALVE must not be energized together. The electrical circuit should be designed to prevent this.

The second important cause of burnt out solenoids is the simultaneous energizing of two solenoids as on a 3-position, spring-centered valve. The valve diagram shown should make it plain that if solenoids *A* and *B*, each attempting to push the valve in a different direction, are energized together they will burn out together; or solenoid *A* will win the tug of war and solenoid *B* will burn out because it is locked open; or solenoid *B* will triumph, move the valve, and solenoid *A* will burn out.

You must examine your circuits carefully to insure that two solenoids of the same valve can not be energized at the same time. Possibly the fact that most mechanically latched relays are made so that it is safe (although perhaps rediculous) to energize the latch and unlatch coils at the same time, has made circuit designers careless with valve solenoids.

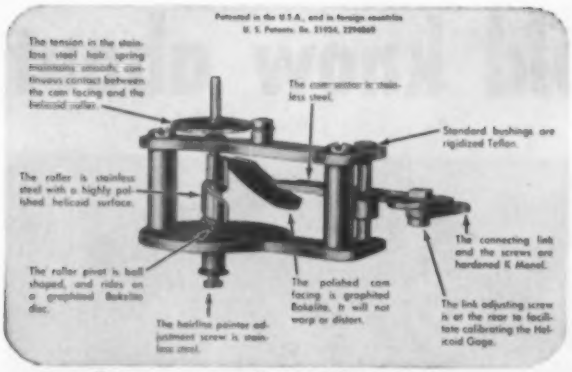
The last cause of failure in solenoids is foreign material entering the covers, jamming the plunger open or preventing proper seating. If the solenoid valve operates for any length of time, a piece of dirt on the

Continued on page 98

Things You Should know about

Vogt
FORGED STEEL
VALVES, FITTINGS
FLANGES & UNIONS
Vogt FORGED STEEL
22 World's most complete line of forged steel valves, fittings, flanges, and unions
HENRY VOGT MACHINE CO., LOUISVILLE, KY.
COMPLETE DATA IN CATALOG F-10
HENRY VOGT MACHINE CO.
LOUISVILLE, KY.
Vogt
World's Most Complete Line of Forged Steel
Valves, Fittings, Flanges & Unions

Circle **134** on Time-Saver Card


Patented in the U.S.A., and in foreign countries
U. S. Patents, Re. 21934, 2294869
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is stainless steel.
Standard bushings are rigidized Teflon.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

Exclusive Helicoid movement provides *Sustained Accuracy* ...on the toughest jobs!

• Helicoid Gages have no gears, no teeth—wear is reduced to an absolute minimum. No danger of fouling, either—rolling action of cam facing keeps contact surface clean. Even when subjected to violent pressure pulsations or mechanical vibrations, Helicoid Gages *stay* accurate. Only Helicoid Gages provide *all* these advantages:

Sustained accuracy—Helicoid movements have been tested through 75,000,000 cycles, with virtually no wear or loss of accuracy. Conventional *geared* gages on the same test became useless after only 500,000 cycles.

Durability—Bourdon tubes won't stretch, leak or crack. Dial faces won't corrode or chip.

Wide selection—Gages are available for practically any application from tap water to acid. Gages include flanged and flangeless, round and square, in standard and flush-mounting models. Accessory equipment includes gage cocks, needle valves, siphons and snubbers.

NEW! Solid-Front Safe-T-Case Gage

This new Helicoid design diverts the force of a burst in a backward direction, away from the operator. The force escapes by deforming the back cover plate, which can then be replaced inexpensively.

Write for Catalog DH-65 for details on the complete line of Helicoid Gages

Distributed in Canada by Upton, Bradeen & James, Ltd.
Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Edmonton, Vancouver

HELICOID GAGES

Helicoid Gage Division • American Chain & Cable Company, Inc.
929-H Connecticut Ave., Bridgeport 2, Conn.

ACCO

Circle **60** on Time-Saver Card

WHY SOLENOIDS BURN OUT

Continued from page 96

plunger faces creates enough air gap to overheat the coil.

Foreign matter can get into a solenoid in three ways. One is through the valve cover. These usually are gasketed and oiltight, and dirt gets in because someone was careless in tightening the cover screws.

Of course there is the occasional "YaHoo" who leaves the cover off so it's easier to replace a coil. Dirt also can get in through the conduit; in fact, it is surprising how much dirt, oil and water get into valve solenoid enclosures that way. Condensation is the biggest enemy, but even sizeable chunks of dirt will sometimes course through conduit like embolisms in the cardio vascular system. Sealing is the only remedy and many good devices are on the market.

Finally, there is dirt "manufactured" internally: One of the greatest passions in industry has been hermetic sealing of everything. This overlooks the fact that any device containing moving parts tends to be a dust and dirt generator itself. Some of this dirt may eventually interfere with the proper functioning of the device in question. If however, you keep the covers on tight and the conduits sealed, the effect of internally generated dirt will not be felt for a very long time. Added, to external contamination, however, it does assume some importance.

• **Protecting valve solenoids**—Most solenoid burnout can be directly traced to a few specific causes. Once these are overcome, there should be much fewer burn outs. On the other hand, users still may want to protect solenoids with fuses or other devices. Unfortunately it's not so simple.

As mentioned before, variable air gap devices draw inrush currents much greater than their seal currents. Normally, this high current lasts only for a very short time, because closing time of the typical solenoid valve operator is not much greater than one or two cycles. Therefore, these coils cannot be economically designed to withstand this inrush current for much longer than that. If we fuse each individual solenoid, the fuse must be selected at a value not much greater than the seal current rating of the coil, and must be a very high speed device. Solenoid seal currents vary among manufacturers, and so do ratios of inrush to seal currents. Selecting a fuse which protects the device and at the same time does not blow constantly is a very difficult and unpredictable task.

Considerable work has been done to produce a thermal protective element which can be applied in the same way that thermal overload protection is now used for electric motors. However, one can see that this too is a formidable task. A delayed, magnetic, instantaneous trip device would in itself be of no value, since lacking any thermal memory, it could not protect against excessive duty cycle. Perhaps the solution lies in a combination of the two. Right now, the only safe bet for the user is to avoid the common pitfalls. ▼▼▼

For Hannifin items Circle **58**
For Fittings & Hose Circle **102**

PARKER-HANNIFIN FLUID SYSTEM COMPONENTS

Hannifin air power cylinders, available in a full range of mounting styles, bore sizes from 1½" through 14", strokes to 20 feet. Cylinder bodies bored, then honed satin-smooth . . . for low friction, long packing life.

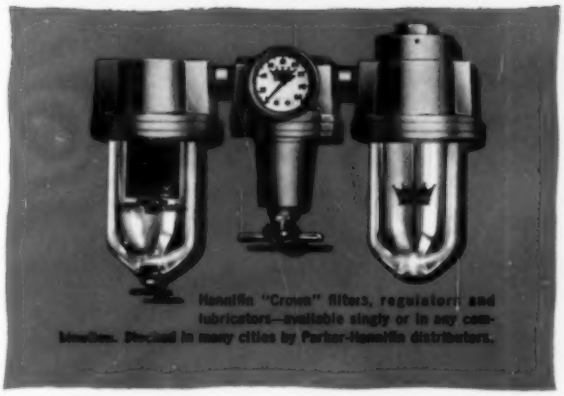
Hannifin's complete line of air control valves includes electric solenoid-, pressure-, cam-, hand-, and foot-actuated valves. Write for our compact data "Valve Finder."

PARKER-HANNIFIN

puts air to work without costly leaks

Now...complete pneumatic power systems, engineered for long leak-proof life, are available from your Parker-Hannifin man. Hannifin "Crown" units supply filtered, lubricated air at optimum pressure. Hannifin air valves shift quickly and seal bubble-tight. Hannifin air cylinders and air motors are low-friction, leak-proof. Parker "Push-lok" hose fittings and "Intru-lok" tube fittings provide quick, easy, leak-proof connections. The over-all result is more work from less air!

Our field engineering service helps you design your circuits and select the components. Many items are available locally, from Parker-Hannifin distributor stocks.



Hannifin "Crown" filters, regulators and lubricators—available singly or in any combination. Stocked in many cities by Parker-Hannifin distributors.

The Hannifin air motor combines a high-efficiency, leak-proof power cylinder and its electric control valve with built-in speed controls into one compact package. A single air line connection is needed, reducing installation costs.

A bench-backed hand push joins Parker "Push-lok" hose fittings to Parker hose. No tools required. Won't blow off.

Parker "Intru-lok"® tube fittings are for low and medium pressure lines in copper, aluminum, nylon or polyethylene. You simply insert the tube end and tighten the nut. No-leak, vibration-proof grip.

Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

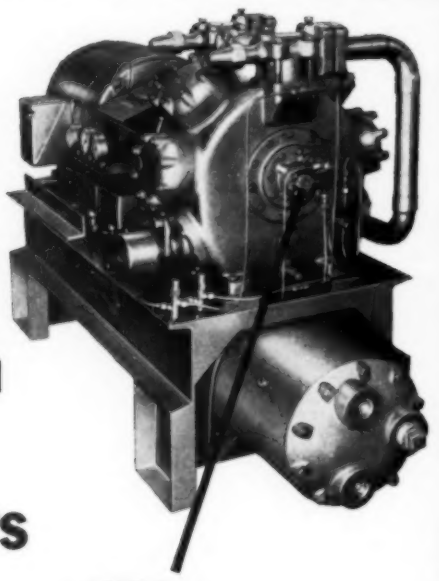
HANNIFIN COMPANY
555 S. Wolf Road, Des Plaines, Illinois

DIVISIONS OF PARKER-HANNIFIN CORPORATION

Another pump problem . . . solved by **TUTHILL**

TUTHILL PUMPS

For Positive Lubrication of New Brunner Multi-Drive Compressors



The new Multi-Drive refrigerating compressors recently announced by the Brunner division of Dunham-Bush have been "engineered to insure extreme dependability, greater flexibility, maximum performance characteristics, and highest quality".

With these objectives naturally Brunner selected Tuthill lubrication pumps as an integral part of the forced feed lubricating system. Based on their long experience in working together, Brunner knew that Tuthill's engineers would propose a reliable unit which could be incorporated in their new equipment with the greatest possible ease . . . and would most closely meet the performance characteristics demanded by the application.

Special features

The Tuthill units finally developed reflects Tuthill's proven ability to "Fit the pump to the problem". These are modifications of Tuthill's model RLV, provided in two different sizes to cover the complete range of compressors. They have Tuthill's special reversing feature . . . required in this instance since the compressors are designed to run in either direction. At the customers request, they are provided with relief valves and a specially modified shaft extension.

And a complete new housing was designed to incorporate the unit directly into the compressor for greatest possible ease of assembly and most attractive appearance.

Over 800 models

Hundreds of industrial leaders like Dunham-Bush have learned the advantages of bringing their pump problems to Tuthill. For Tuthill offers a complete selection of over 800 standard models . . . plus extensive engineering skills and experience in adapting these standard pumps to fit the requirements of special applications. There reliability has been proven by thousands of demanding applications including lubrication, coolant hydraulic, oil burning, circulating . . . the list could go on and on.

Catalog 100 gives an overall view of Tuthill's comprehensive line. Write for your copy today . . . or better yet forward details on your application for our engineering proposal.

Tuthill manufactures a complete line of positive displacement rotary pumps in capacities from 1 to 200 GPM; for pressures to 1500 PSI; speeds to 3600 RPM.

PUMPS FOR YOUR PURPOSE

TUTHILL PUMP COMPANY

981 East 95th Street, Chicago 19, Illinois

Hydraulics & Pneumatics

June 1960

AIRCRAFT SECTION

MISSILES • SPACE VEHICLES • GROUND SUPPORT

HOW TEMPERATURE AFFECTS HYDRAULIC SERVO PERFORMANCE 102

By August S. Lermer

Newly developed graphical method indicates servo system performance as a function of temperature. Hydraulic fluid bulk modulus is affected by temperature, decreasing as temperature goes up.

PRESSURE SENSING ACTUATOR SPEEDS WIPER REVERSAL 108

By Jack H. Eichler

Design details of the hydraulic windshield wiper for the Lockheed Electra. It operates against high wind forces regardless of system pressure.

AVIATION NEWS FROM THE FLUID POWER FIELD 112

AIRCRAFT COMPONENT DATA 116

EDITORIAL ADVISORY BOARD

• **Charles H. Cannon** Lockheed Aircraft Corp. • **H. G. Conway** Short Bros. & Harland Ltd. • **Howard D. Davis** Convair Astronautics • **Kenneth W. Dubois** Douglas Aircraft Co. • **William E. Mayhew** Republic Aviation Corp. • **Ralph E. Middleton** Lockheed Aircraft Corp. • **E. T. Raymond** Boeing Airplane Co. • **John W. Ruttle, Jr.** The Martin Co. • **W. F. Talbot** Northrop Aircraft, Inc. • **Frank Mladinich** Grumman Aircraft Engineering Corp.

When a hydraulic fluid's temperature increases, its bulk modulus decreases and system performance changes. A simple, graphical method using a temperature-response diagram indicates whether a proposed system will perform within the established safety limits. The T-R diagram, indicating changes needed, helps in designing new components.

How temperature affects hydraulic servo

• By **AUGUST S. LERMER,**
Design Engineer, Convair, A Div. of General Dynamics Corp., San Diego, Calif.

This article was awarded $100 *in the* 1959 HYDRAULICS & PNEUMATICS *Prize Paper Contest.*

FREQUENCY response is a measure of control system performance. It is the ratio of output displacement, or amplitude, to input amplitude. Each system has its own frequency response characteristic depending on the natural frequencies of its components.

The system diagram in Figure 1 illustrates the meaning of output and input amplitude. The system consists of a suspended weight, spring, and damper. It has one degree of freedom and is subjected to sinusoidal oscillations about equilibrium axis x-x. Displacement Y_i is input displacement (amplitude) or input for short. Y_o is output displacement or simply output. The amplitude ratio is output divided by input Y_o/Y_i.

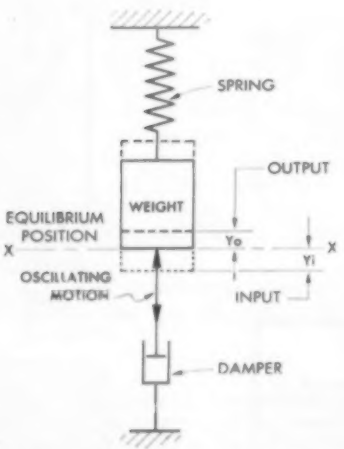


FIG. 1. INPUT FORCE acts upon a typical system producing oscillations about the equilibrium axis.

Frequency ratio is also a measure of sysetm performance. It is obtained by dividing the frequency of the input motion by the system's natural frequency, f_i/f_n.

Damping ratio D.R. is the ratio of the actual damping of the system to that necessary for critical damping.

The curves in Figure 2 show the amplitude and frequency ratios under various damping conditions. For example at point A_1, D.R. is 0.5, frequency ratio is 0.8, and the amplitude ratio is 1.15. This means output exceeds input by only 15%, which indicates good system stability but slow response.

Response can be speeded by decreasing the damping ratio of the system. This can be done by:

- Increasing the amplitude ratio at constant frequency ratio to A_2. The natural frequency and stiffness of the system remain unchanged, so no strength and weight increase is necessary. The output amplitude, however, is over 250% of input. This may endanger the system and is not a good solution.
- Decreasing frequency ratio at constant amplitude ratio to A_3. A constant amplitude ratio is desirable, but this method gives a low frequency ratio. This means a high, natural frequency, and a stiffer, heavier, bulkier system.
- Decreasing freguency ratio and increasing amplitude ratio to A_4. This gives a good compromise of system performance, weight, and space.

A simple, graphical method using a temperature-response diagram permits analyzing the influence of increased hydraulic fluid temperature on the frequency response of a hydraulic control system. Amplitude ratio, frequency ratio, and damping ratio are the main parameters which determine its characteristics. The curves in Fig. 2 show how they are related. Each point on a curve represents a system having specified properties of performance, weight, and space.

Optimum design of a control system is a compromise of performance, weight, and space. Guides or limits on the ratios can be established. They identify the values of the ratios which pro-

performance

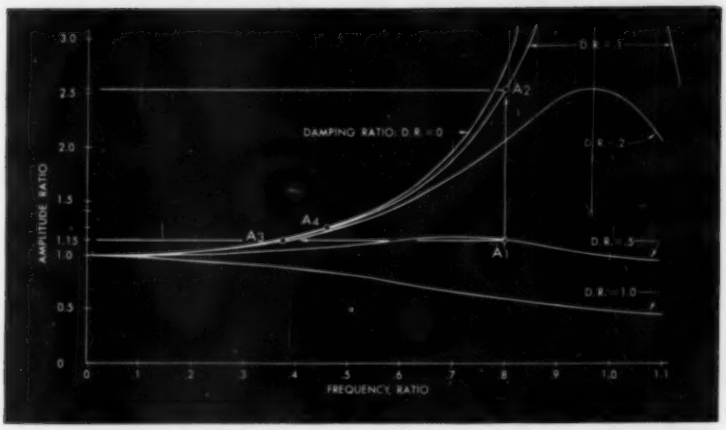


FIG. 2. VARIOUS DAMPING RATIOS can be chosen. D.R. of 0.5 will give good stability but slow response. D.R. of 0.1 will give fast response.

duce poor performance or require excessive weight or space.

• **Establishing safe limits**— The amplitude ratio should not increase beyond a safe limit called *amplitude limit*. This limit, *x-x* in Figure 3, is derived from statistical data which show that amplitude ratios above 1.41 are not generally good.

To remain safe, away from the amplitude limit, a safety zone can be etsablished whose lower limit is the *amplitude margin* X_1-X_1. It has been arbitrarily selected at 1.25, as a matter of judgment, as is the safety factor in the strength of materials.

For sufficiently fast response use a damping ratio of 0.1. This locates points A_4 and A_5 on amplitude margin X_1-X_1 and amplitude limit *x-x*.

Line *z-z* through A_5 is the *frequency limit*, Line Z_1-Z_1 through A_4 is the *frequency margin*. This establishes the frequency safety zone.

The amplitude and frequency safety zones in Fig. 3 enclose an area which represents systems having these properties:

- Amplitude ratio within safe limits.
- Sufficiently fast response due to low damping.

Continued on next page

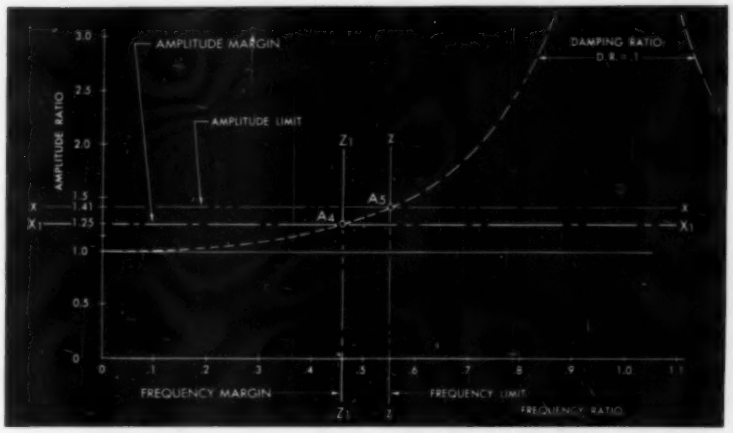


FIG. 3. AMPLITUDE SAFETY zone is established by selecting 1.41 and 1.25 as the amplitude limit and margin. Points A_5 and A_4 are located when D.R. of 0.1 is selected. This fixes the frequency safety zone by establishing the frequency limit and margin.

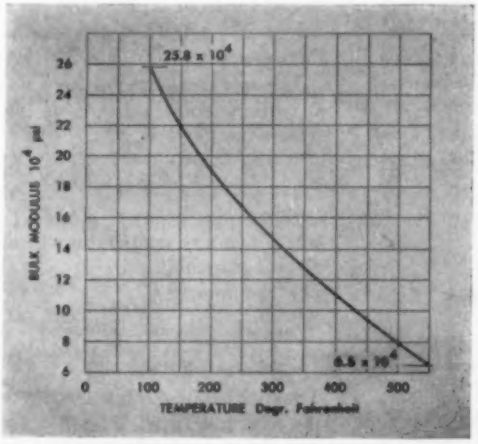


FIG. 4. VARIATIONS IN THE BULK MODULUS of a typical hydraulic fluid at 3000 psi. Bulk modulus measures the compressibility of a liquid. An easily compressible liquid has a low bulk modulus.

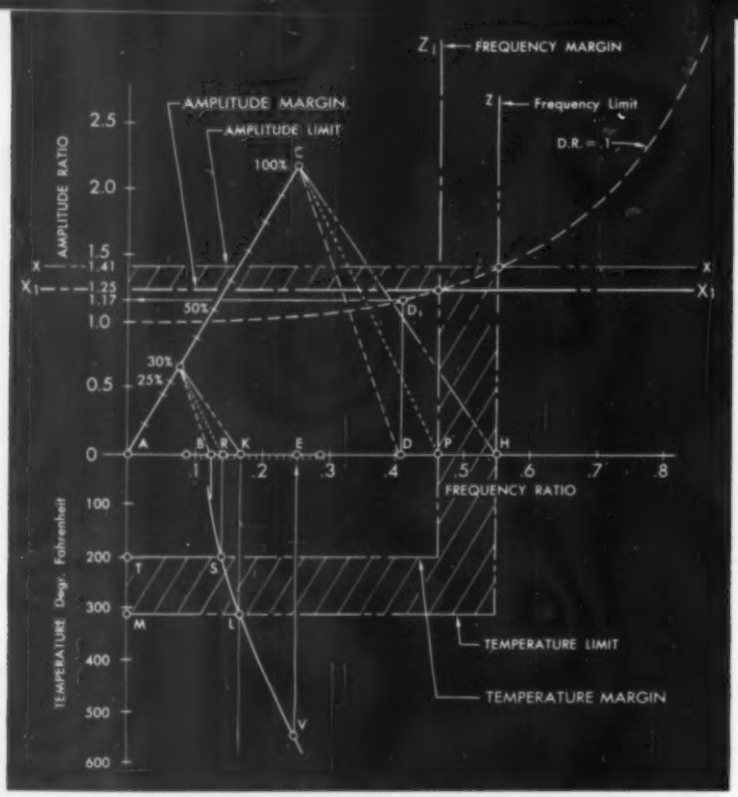


FIG. 5. TEMPERATURE-RESPONSE DIAGRAM. Temperature curve JSVL is based upon an actuator whose frequency ratio is 0.125 at 100 F. Co-ordinates for a point on the curve at a higher temperature are calculated from equation 2. The temperature safety zone is derived from previously established amplitude and frequency zones and D.R. of 0.1.

- Reasonably low frequency ratio which requires no excessive stiffness, weight or space.

The third safety zone, temperature, established by the graphical method, follows after a discussion of the affect of increased temperature on system response.

• **How increased fluid tem-Response**—Performance of a hydraulic system varies with fluid temperature. Higher fluid temperature decreases bulk modulus E of the hydraulic fluid, so natural frequency f_n of the system decreases, with slower response. This is seen in equation 1 for a hydraulic actuator:

$$f_n = \frac{1}{2\pi}\sqrt{\frac{E \times A}{m_o} \times \frac{x_o}{2}} \quad \ldots\ldots (1)$$

where: f_n . . . Natural frequency of the actuator, cps.

E . . . Bulk modulus of the hydraulic fluid at the given temperature, psf.

A . . . Piston area, sq ft.

m_o . . . Inertia load reflected to piston rod, slugs.

x_o . . . Maximum piston displacement, ft.

The piston area, the reflected inertia load, and the maximum piston displacement are constant for a given control system and are practically independent of temperature change. The only variable is the bulk modulus of the hydraulic fluid. Bulk modulus decreases as temperature increases. The curve shows that bulk modulus drops from 25.8 x 10^4 psi to 6.5 x 10^4 psi when temperature increases from 100 F to 550 F.

The actuator's natural frequency at various temperatures is derived from equation 1

$$\frac{f_{nt}}{f_{n100}} = \sqrt{\frac{E_t}{E_{100}}} \quad \ldots\ldots (2)$$

where t is any temperature in degrees Fahrenheit.
For example:

$$\frac{f_{n500}}{f_{n100}} = \sqrt{\frac{6.5 \times 10^4}{25.8 \times 10^4}} = \frac{1}{2}$$

Thus a rise in the temperature of the hydraulic fluid from 100 F to 550 F would cut the natural frequency of the actuator in half. Frequency ratio increases with fluid temperature because f_{nt} decreases and input frequency remains constant. The fluid's 100 F to 550 F temperature increase doubles the frequency ratio.

• **Temperature-response Diagram**—To plot the temperature curve in Figure 5 assume the actuator's frequency ratio at 100 F is 0.125, point J. Then point V for 550F is 0.250. Other points to develop the curve are similarly found using equation 2.

The analysis on the Temperature-Response Diagram is a graphical method based on the geometric theorem that corresponding sides of similar triangles are proportional.

The analysis of the hydraulic system is based on the following data:

(1) Frequency ratio of a hydraulic actuator at 100 F is 0.125 (AB).
(2) The actuator's frequency ratio is 30% of the system's frequency ratio.
(3) Fluid characteristics are as shown in the bulk modulus-temperature curve.
(4) Damping ratio is 0.1.
(5) Amplitude margin and amplitude limit are 1.25 and 1.41.

Frequency margin and frequency limit are then 0.46 and 0.55.

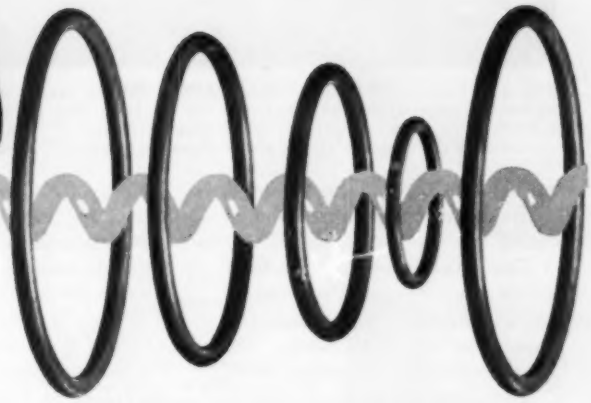
First determine system frequency ratio from actuator frequency ratio. Point B is a projection of J. It is the 30% contribution of the actuator to the frequency ratio of the entire system. Through A draw AC, a random, straight line of convenient length and angle. Lay off percentage graduations on AC. Connect B with the 30% point. Through C draw CD parallel to line B-30%. AD is the system's frequency ratio. The frequency response of the total system is within the safety margin AP.

• **Establish temperature limit and safety zone**—Next determine the temperature margin. Connect frequency margin P with point C. A line parallel to PC through the 30% point on AC will intersect at R (0.131). R projected onto the temperature curve intersects at point S which determines the temperature margin at 200 F. Similar-

Continued on page 106

Call your National Applications Engineer for

engineering help
fast delivery
uniform quality
special compounds
on O-Rings



National's District Field Offices give you fast service on O-Ring engineering problems and O-Ring procurement. You talk with seasoned field engineers equipped with the latest O-Ring information and backed up by the plants of one of America's largest sealing products manufacturers. National O-Rings are precision-made, uniform in quality, specified and used by leading equipment manufacturers across America.

NATIONAL SEAL

Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio; Redwood City and Downey, California

CALL YOUR NATIONAL FIELD ENGINEER

Atlanta 8, Georgia: George W. Smith Company, 394 Williams St., N.W., JAckson 3-7140; **Chicago (Franklin Park) Illinois:** 10013 West Grand Ave., GLadstone 5-4420; **Cleveland 16, Ohio:** 210 Heights Rockefeller Bldg., 3091 Mayfield Road at Lee, YEllowstone 2-2720; **Dallas 19, Texas:** Benson Engineering Company, 2514 West Mockingbird Lane, FLeetwood 2-7541; **Detroit 27, Michigan:** 13836 Puritan Avenue, VErmont 6-1909; **Indianapolis 5, Indiana:** 2802 N. Delaware St., WAlnut 3-1535; **Kansas City (Prairie Village) Kansas:** Benson Engineering Co., 2902 West 72nd Terrace, ENdicott 2-2843; **Los Angeles (Downey) California:** 11634 Patton Road, TOpaz 2-8163; **Milwaukee 4, Wisconsin:** 647 W. Virginia Street, BRoadway 1-3234; **Red Bank, New Jersey:** 16 Spring Street, SHadyside 7-3242; **Wichita, Kansas:** Benson Engineering Company, 519 So. Broadway, AMhurst 2-6971

6342

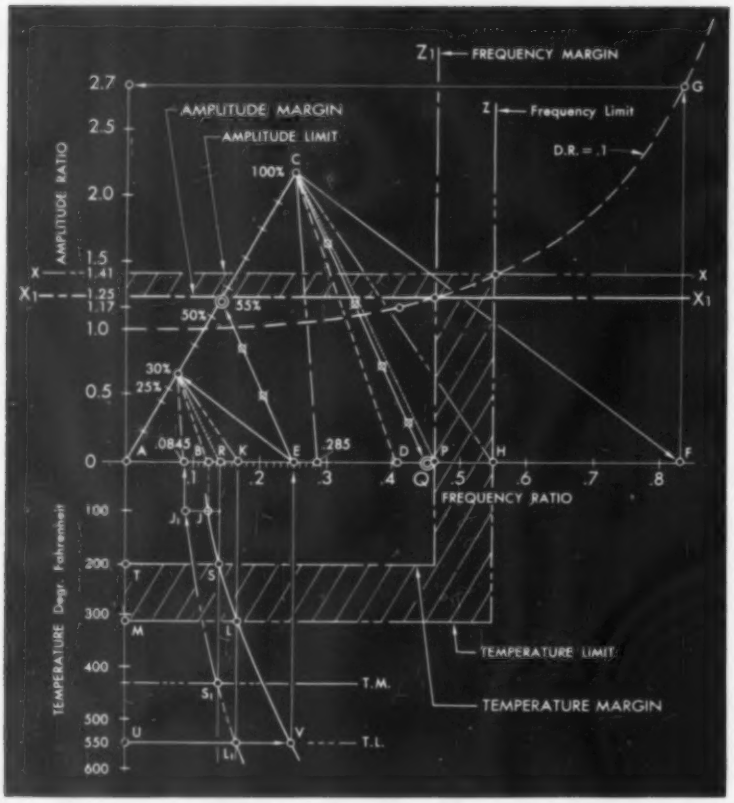


FIG. 6. AREA WITHIN THE THREE SAFETY ZONES can be used to choose component parameters, so that the system will be safe. New temperature curve $J_1S_1L_1$ indicates the proposed actuator must have a frequency ratio of 0.0845. This is achieved by changing the stroke, piston diameter, hydraulic fluid or all three.

ly, lines *HC*, *K*-30%, and point *L* produce the temperature limit at 320 F.

The area enclosed by the three safety zones represents safe operating conditions. The shaded area represents marginal safety. The space outside is of doubtful safety.

The temperature limit 320 F pertains to the hydraulic fluid only. It does not imply that ambient temperatures cannot exceed this limit without impairing the control operation of the system. Ambient temperatures can run as high as materials can stand. If necessary, it is easy to insulate and cool the system. The improved frequency response offsets the slight weight increase.

• **If a higher temperature limit is needed?**—Suppose the temperature limit is increased without insulation or artificial cooling. If it raised to 550 F from 320 F, the actuator's frequency ratio will move from *K* to *E*. The system's frequency ratio becomes 0.83 (*AF*), in Figure 6, found by the graphical method previously used. It exceeds the safety limit by over 50%. (0.83/0.55 is 1.51). The new amplitude ratio is 2.7 (point *F* to *G* to 2.7). It exceeds the safety limit by over 90%. (2.7/1.41 is 1.92). Both are far beyond safety limits. What can be changed to maintain operational safety at 550 F?

• **New temperature curve**—Assume that no change is wanted in the amplitude and frequency limits and the damping ratio. The amplitude and frequency safety zones are not changed. Also, the actuator's share of the system frequency ratio remains at 30%.

Thus the actuator's frequency ratio at 320 F is 0.17 (*AK*) and is not changed for 550 F.

This establishes one point L_1, the new temperature limit on the new temperature curve. Establish the remaining points on the new curve by using equation 2.

Find the new temperature margin by projecting point *S* onto the new temperature curve at S_1 at 430 F. Each new temperature curve represents an actuator and system having different characteristics. Thus, shifting the temperature limit requires a change of the actuator's frequency ratio from 0.125 to 0.0845 at 100 F.

A vertical line through the intersection of a temperature limit and its corresponding temperature curve, such as point L_1 is the locus of all such intersections for a given component at various operating temperatures. The same is true of temperature margins.

• **Designing new components**—The new frequency ratio can be translated into new component parameters by using equation 1. Natural frequency has increased by a factor of 1.485 (0.125/0.0845). For manipulation under the root symbol in equation 1, 1.485 should be squared to 2.2.

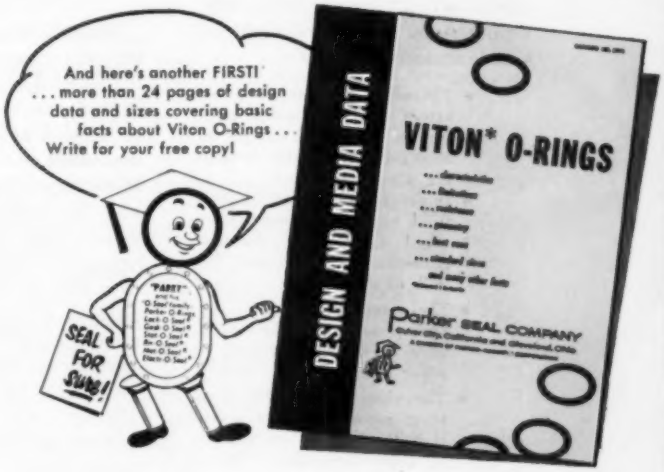
The designer may increase the piston area 2.2 times corresponding to an approximate 50% increase of the piston diameter. Or the stroke can be shortened 2.2 times. Also a hydraulic fluid can be selected whose bulk modulus is greater than the given one. A combination of all three possibilities probably would be tried.

• **Unanalyzed frequency ratio**—Another design subject is the remaining 70% of the system's frequency ratio which has not been analyzed. A great part of this depends on actuator mounting. Standard designs can be improved to compensate for the influence of high temperature on hydraulic fluids.

Decreasing frequency ratio in this way could shift the contribution of actuators from an average 30% to about 55%. Lines *E*-55% and *CQ* indicate the frequency ratio *AQ* of the entire system is within the safety margin, although the operating temperature is 550 F. At the same temperature, but without improved mounting, the identical system Frequency ratio was *AF* and the amplitude ratio exceeded safety limits by over 90%. ▼▼▼

NOW—VITON O-RINGS IN ALL A.N. OR A.R.P. STANDARD SIZES

One of the first to embark upon a research and development program for Viton O-rings, Parker Seal Company now makes another significant advance in this versatile high temperature material by offering Viton O-rings in all A.N. or A.R.P. standard sizes. This means faster delivery and greater economy for all these popular O-ring sizes. It's another plus result of **responsible leadership** *in O-ring engineering by Parker.*

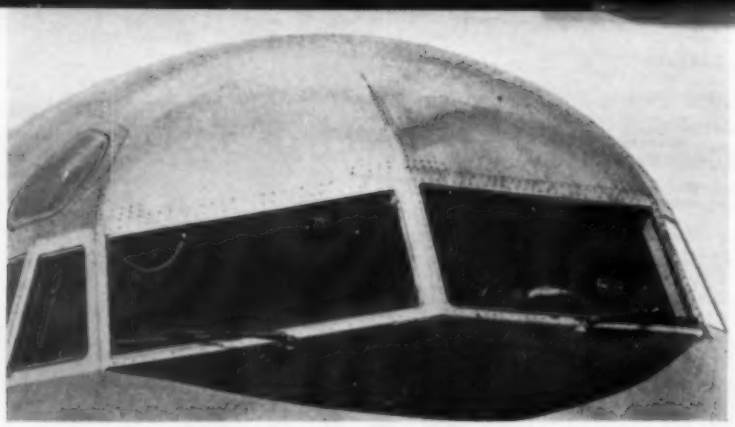

And here's another FIRST! . . . more than 24 pages of design data and sizes covering basic facts about Viton O-Rings . . . Write for your free copy!
SEAL FOR SURE!
DESIGN AND MEDIA DATA
VITON* O-RINGS
Parker SEAL COMPANY

Parker SEAL COMPANY

Culver City, California and Cleveland, Ohio

A DIVISION OF PARKER-HANNIFIN CORPORATION

Circle **103** on Time-Saver Card



Pressure sensing actuator speeds wiper reversal

• By **JACK H. EICHLER** *Marquette Div., Curtiss-Wright Corp., Cleveland, Ohio*

A PRESSURE-SENSING, valve actuator which compares two pressures and has trigger-action valving reversal is the heart of a high performance, hydraulic windshield wiper used on the Lockheed Electra 188. The system was developed to meet the design specifications drawn up by engineers of Lockheed Aircraft and Curtiss-Wright for a radically new wiping system. The following desirable features were listed:

- The wiper must operate at all values of aircraft system pressure in the range 800 psi to 3000 psi with constant or varying aircraft pressure.
- In order to overcome the high wind forces generated by the speed of the aircraft, the wiper must develop about 700 in-lb of torque.
- The maximum prevailing aircraft pressure must be utilized in each stroke regardless of wiper speed or control setting.
- The wiper must be able to reverse anywhere in its stroke if it should meet ice barriers or other obstacles.
- The remaining window units must continue to run normally even when a campanion window unit is partially or completely blocked.
- There will be an internal mechanical lock to hold the wipers in the stowed position when not operating.
- The stowed (parked) position will lie outside the wiped area. Visibility requirements dictated off-the-glass parking.
- The whole system must pass a 240-hour life test under simulated wind load and pass environmental tests in sand, salt spray, humidity, vibration, and operate at —65 F to 185 F.

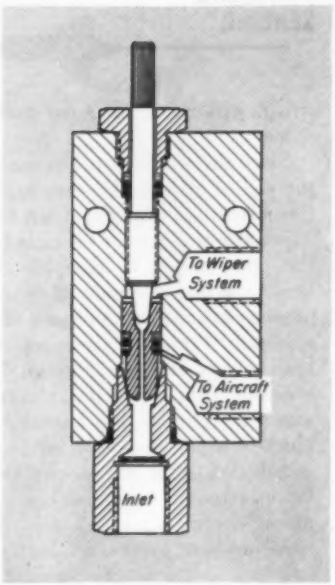
Normal valve sequencing used in the past required the reciprocating wiper drive to dwell at the end of each stroke while the actuator reversed. Dwell time caused erratic movement to the blades and arms. More important, since the wiper had to make 300 strokes/min, dwell time required a higher average velocity. Long deceleration and acceleration further increased average velocity to complete 5 strokes/sec. High instantaneous velocity required complex damping design.

A way was needed to keep the valving moving at the same time as the wiper.

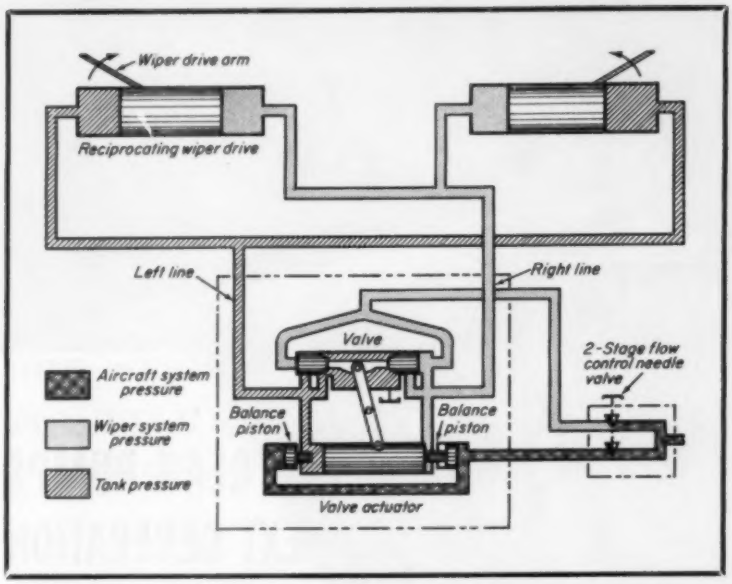
• **Valve actuator triggers directional valve**—In the system design by Marquette Division, a pressure-sensing, valve actuator compares the aircraft system pressure with the varying pressure on the wipers. When the valve actuator's piston reaches the end of its right stroke, a spring-actuated mechanism snaps the directional valve left. This opens the valve's left tank port allowing wiper system pressure in the left line to drop to zero. Wiper pressure increases in the right line so the wipers reverse.

When the valve's actuator piston moves right, it contacts the right balance piston and forces it out against aircraft system pressure, even though wiper pressure is less than aircraft pressure, because the actuator piston is larger than the balance piston. Wiper pressure rapidly approaches aircraft pressure at the end of the wiper's stroke.

When wiper pressure on the left face of the actuator drops to zero, the right balance piston pushes the actuator left. Pressure in the right line begins to increase and moves the actuator even after the right balance piston loses contact with it. The actuator makes contact with the left balance piston and they move left. Because of the ratios of their areas, balance occurs when



NEEDLE VALVE CONTROLLING SPEED operates in two stages by turning one knob. The balance port first opens and applies system pressure aganist the two balance pistons of the valve actuator. As the knob is turned farther, the second stage opens porting fluid to the wiper drives through the valve actuator. The needle valve also meters fluid as needed directly from the aircraft system. It turns the system on and off, controls frequency of stroke, and parking the blades.

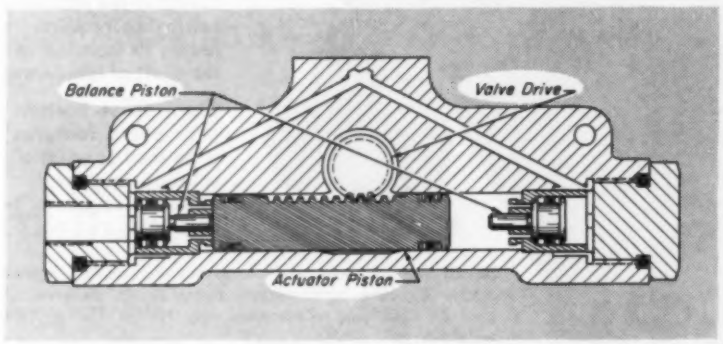


DIRECTIONAL VALVE HAS JUST REVERSED. Wiper sytsem pressure has begun to increase in the right line. Pressure in the left line is zero. Wipers move inboard as wiper pistons move outboard.

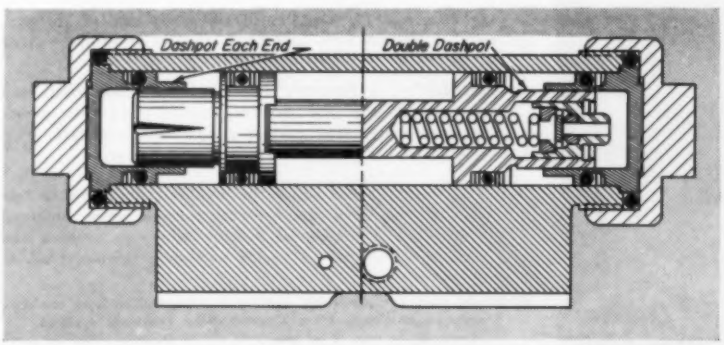
wiper pressure is slightly smaller than aircraft pressure. The valve shifts right, reversing fluid flow in the wipers.

• **Short wiper dwell**—The wiper piston and valve actuator piston reverse fast because wiper pressure drops to zero on one face as it begins to increase on the other. This gives very slight dwell at the end of the stroke. The pistons each have the same varying pressure, so they reciprocate together. Reciprocation does not depend on aircraft pressure. It occurs because once each stroke, wiper pressure nearly equals aircraft pressure. Aircraft pressure is applied to the wiper each stroke, so maximum torque can be produced each stroke, regardless of speed setting. If a high wind load tries to reduce wiper speed, aircraft pressure and wiper pressure will rise to meet the need, insuring the necessary torque to move the

Continued on next page



VALVE ACTUATOR PISTON PUSHES the left balance piston to its retracted position, triggering the valve when actuator piston equals balance piston force.



V-GROOVES AT EACH END OF THE WIPER PISTON exhaust the fluid at a decreasing rate to slow the piston. The double dashpot at one end shortens the wipers' travel at high speeds. Below 125 strokes/min, it is not effective and allows the wiper to move off the glass to the parked position.

HIGH SPEED GEAR PUMPS
FOR THE NEXT GENERATION
OF AIRCRAFT • MISSILES • SPACECRAFT

High performance hydraulic pumps by Eastern are uniquely suited to the exacting operating requirements demanded in the craft of tomorrow.

Check these Eastern gear pump features — do they suggest a solution to your present design problem?

Small size: Eastern gear pumps are the smallest, lightest made. Airborne servo system pump shown delivers 1.5 gpm @ 1500 psig — measures only 1⅞" x 1⅞" x 2¼", weighs 9 oz.

Wide performance range: pumps available have theoretical displacement from .0016 to .0419 cu. in. per revolution — flow from .025 to 2.0 gpm, pressures from 0 to 2000 psig, at speeds to 24,000 rpm. Weights with motor range from 1.5 to 8.5 lbs.

Unaffected by extreme environments: rugged, reliable Eastern units take loads to 50g in stride — shrug off temperature differentials to meet MIL specs.

Flexibility, economy: mass-produced components can be teamed into the precise configuration you need. Creatively-engineered custom pumps also available.

Contact Eastern for creative contributions to help you solve your hydraulic pump or power problems. Write for Bulletin 360 — your complete new guide to Eastern aviation products.

Hydraulic power • electronic cooling • refrigeration-type cooling pressurization-dehydration • servo-valve hydraulic systems

EASTERN INDUSTRIES, INC.
100 Skiff Street • Hamden, Conn.

Los Angeles Office: 4203 Spencer St., Torrance, Calif.
Tel: FRontier 6-1921

Circle **40** on Time-Saver Card

PRESSURE SENSING

wipers with no effect on the stroke speed.

Since the wipers synchronize at the end of each stroke, they begin the next stroke together. A blocked wiper arm waits at the obstacle for the other wiper to complete its stroke. Wiper pressure then increases to aircraft pressure for reversal. Pressure increases in both wipers and produces an increasing torque in the blocked wiper to dislodge the barrier. A blocked wiper does not interfere with action of the other wiper. One valve actuator operates one or more wipers in parallel, with the same pressure, torque, and motion.

• **Window drive damping**—Each wiper piston has throttling grooves at each end. Fluid exhausts through decreasing area of V-grooves as the piston approaches the end of its travel. An oscillograph record shows a gradual build-up of damping pressure in the normal dashpot as the wiper piston slows down.

• **Parking**—The wiper piston also has a double dashpot which influences off-the-glass parking and overtravel compensation. It has exceptionally stiff damping (over 2000 lb) which limits wiper travel at high speeds, cutting off a few degrees at the end of the stroke. This compensates for overtravel (bending of the arm) by shortening the travel of the wiper piston in the upper two-thirds of the speed range. Below 125 strokes/min, the double dashpot collapses and permits wiper travel to increase 10 degrees outboard, so it moves off the glass into the stowed position.

The pilot parks the wiper by closing the needle valve. As the wiper slows to 125 strokes/min, a spring clutch catches the wiper arm shaft and acts as a mechanical lock to hold the arm in the parked position. The clutch overrides in one direction and holds in the opposite direction. It is hydraulically released for free running in both directions when the system is pressurized. ▼▼▼

Wherever in the world your hydraulic machinery operates . . .

Shell Tellus Oil is there

Other outstanding Shell Industrial Lubricants available world-wide

- **Shell Rimula Oils** – for heavy-duty diesel engines
- **Shell Talona-R Oil 40** – anti-wear crankcase oil for diesel locomotives
- **Shell Alvania Grease** – multi-purpose industrial grease
- **Shell Turbo Oils** – for utility, industrial and marine turbines
- **Shell Dromus Oils** – soluble cutting oils for high-production metalworking
- **Shell Macoma Oils** – for extreme pressure industrial gear lubrication
- **Shell Voluta Oils** – for high-speed quenching with maximum stability

AN INTERESTING FACT!
Every Shell Branded Industrial Lubricant is named for a sea shell. Shown here is the **Cultellus** costatus.

Around the world, Shell Tellus Oil is available—under the same brand name and providing the same performance that your domestic customers rely upon.

Tellus® Oil is top-rated as both a lubricant and control fluid for complex hydraulic systems. Its ability to combat oxidation, rust, sludge formation, wear and foaming has earned it world-wide popularity.

No matter where your hydraulic machinery is shipped, make Shell Tellus Oil your standard recommendation. Write for complete information.

SHELL OIL COMPANY

50 WEST 50TH STREET.....NEW YORK 20, N. Y.
100 BUSH STREET.....SAN FRANCISCO 6, CALIFORNIA
IN CANADA: SHELL OIL COMPANY OF CANADA, LIMITED
505 UNIVERSITY AVENUE.....TORONTO 2, ONTARIO

SHELL

RELIABILITY
AND
PERFORMANCE
are our main products

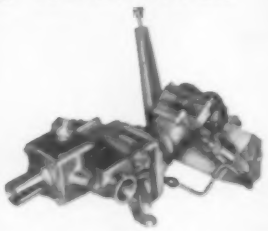
First, imaginative design; then experienced thoroughness through development, tooling, production, assembly and tests, all under strict quality control in an unusually well equipped plant . . . we can help you solve your special problems . . .

- SHUTTLE VALVES

- RELIEF VALVES

- SELECTOR VALVES

- COMPLEX PACKAGES



also

- SOLENOID VALVES
- TRANSFER VALVES
- BRAKE VALVES
- PRESSURE REDUCERS
- FUEL PUMPS
- DEHYDRATORS
- COMPACT COMPRESSORS

WRITE, wire, or phone for data, quotations and service.

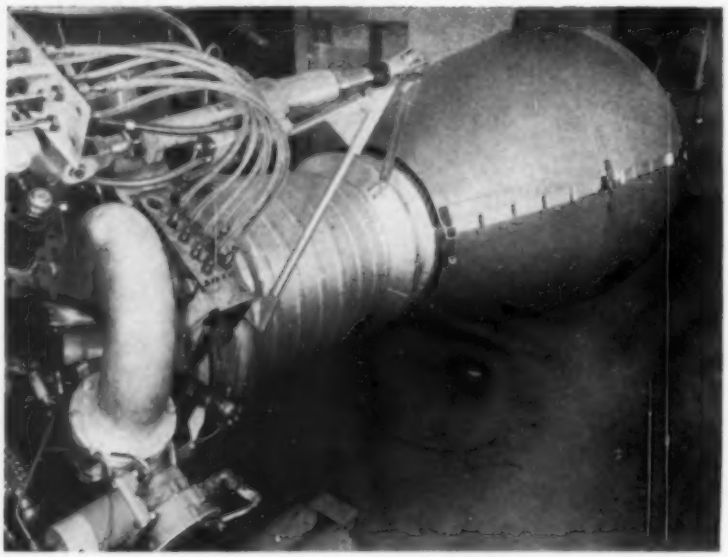
M. C. MANUFACTURING CO.
LAKE ORION, MICHIGAN
PHONE: MYRTLE 3-2711

Circle 83 on Time-Saver Card

AVIATION NEWS

from the fluid power field

Flexible hose for missiles and rockets



Engineers at Rocketdyne, North American, and Douglas were asked in a survey by Titeflex, Inc. why flexible hose is used in rocket engines. Thermal expansion makes connection points move on test stands and on the engine. Hose does not transmit expansion loads to the airframe and engine. Engine vibration must be isolated from the test stand and airframe. If not, frame fittings and the piping itself may fail due to metal fatigue. Hose dampens vibration.

Many designs require movement between the engine and airframe or test stand. Hose allows movement, so permits true thrust measurement. Absolute component alignment is difficult. Combining rigid pipe and hose makes up for alignment differences. Hose can be snaked around obstacles in a packed engine or airframe. Components can be replaced or altered or new components added more easily.

• **Types of Flexible Hose**— All-metal hose with bellows style core and wire reinforcing braid is used where temperatures are extremely high or low, and where there should be no fluid contamination. A similar hose has a die-formed core using wound and brazed metal strip and reinforced with wire braid. It gives increased flexibility but lower fatigue life. Teflon tube reinforced with wire braid is used mainly for hydraulic lines. It has a temperature range of —65 F to 450 F and withstands pressures to 3000 psi.

Rubber hose reinforced with wire braiding is widely used in pneumatic lines. It's inexpensive, and resists chemical damage, but cannot be used with some cor-

Continued on page 114

CONTEST CLOSES JULY 1, 1960

1960 FLUID POWER PRIZE PAPER CONTEST

Articles about:

HYDRAULIC AND PNEUMATIC SYSTEMS AND COMPONENTS

DESIGN • APPLICATION • MAINTENANCE

FIRST PRIZE	$500
SECOND PRIZE	$300
THIRD PRIZE	$200
4th to 7th PRIZES, EACH	$100

All prize papers will be published in HYDRAULICS & PNEUMATICS Magazine. Papers receiving honorable mention awards will also be published and paid for at regular rates.

CONTEST CLOSES JULY 1, 1960

Committee of Judges:

J. A. Draxler, Chief Engineer, Elwell-Parker Electric Co.

R. K. Sedgwick, Assistant Chief Engineer, Servo Machine Tool Div., Kearney & Trecker Corp.

W. E. Mayhew, Staff Engineer, Advanced Fluid Systems Research & Development, Republic Aviation Corp.

SPONSORED BY Hydraulics & Pneumatics

An Industrial Publishing Corporation Magazine

812 HURON ROAD, CLEVELAND 15, OHIO

Circle **240** on Time-Saver Card

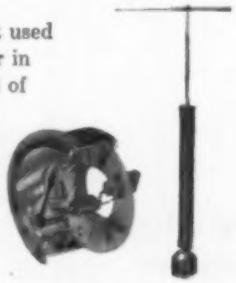
The photograph below shows RMC Pressure Gauges undergoing severe vibration testing on big Calidyne High Frequency Vibration Test System. These gauges undergo accelerated tests from 0-2000 CPS—up to 25 G intensity and up to 350° F.

RMC *direct-drive* Pressure Gauge eliminates vibration problems

The RMC *direct-drive* Pressure Gauge is rugged and resilient. It is the first direct-drive helical bourdon gauge—inlet pressure acts directly on a helical bourdon to drive the pointer. The helical coil, as a simple spring, is resilient and fully balanced, and is not affected by shock or vibration.

With its direct drive, there are no gears or linkage to gyrate and score on vibration—no unbalanced bourdon "C" springs and hair springs to whip. Direct-drive action means a stable pointer—no loss of power, too. Pointer action of the RMC gauge is steady, positive and alive—no need to tap the gauge to read. Soft hair springs and backlash springs are not used.

Shown at far right is the pointer-coil unit used in 3" and 5" concentric models. The pointer in these models is attached directly to the end of the pressure element. At the near right is a cutaway view of the compact 1½" and 2" eccentric models. The pointer in these models is actuated directly by a simple pivot. Both types offer the same direct-drive, helical bourdon advantages. Pressure ranges from 0-1000 to 0-10,000 psi.



Write, wire or phone for general catalog. If yours is a special application, tell us your requirements—RMC engineers will work with you in solving it. Rochester Manufacturing Co., 209 Rockwood St., Rochester 10, N. Y. (Telephone: BRowning 1-2020).

RMC

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

ROCHESTER MANUFACTURING CO., INC., Rochester, N.Y.

Circle **117** on Time-Saver Card

AVIATION NEWS

from the fluid power field

rosive fluids or at temperatures over 275 F. Because Teflon tube is rigid in larger sizes, bends are made by preforming. Titeflex recently developed a flexible hose with a core of Teflon and Fiberglas tapes having wire reinforcement. Its bend radius is only 3½ times ID.

Three engineering changes at Pesco

Appointments in the engineering department at Pesco Products Division, Borg-Warner Corp., Bedford, Ohio have been announced. J. F. Murray has been named director of engineering; Thomas D. Carpenter is manager, future product planning; and Louis J. Schafer is project manager. Murray has had extensive experience

Murray

Carpenter

Schafer

in research, development, and administration of engineering projects for missiles and aircraft. He will be closely associated with long range, technical planning. Carpenter was project manager of Pesco's cryogenic program for missile fuel systems. He will be responsible for future planning, technical analysis, and initial evaluation of products to be developed. Schafer has worked directly with all phases of supervision, design, and development of high en-

ergy fuel and cryogenic pumps. Other changes include the appointment of Thor Holm as manager, engineering design, and Albert Paul, supervisor of design.

Benbow advances at Airaterra

Donald A. Benbow has been promoted to sales manager of Airaterra, Glendale, Calif., by Donald L. Leavitt, president. Benbow was formerly assistant sales manager. Airaterra designs and markets aircraft, missile and industrial components, and quick connect couplings manufactured by Roylyn, Inc.

Benbow

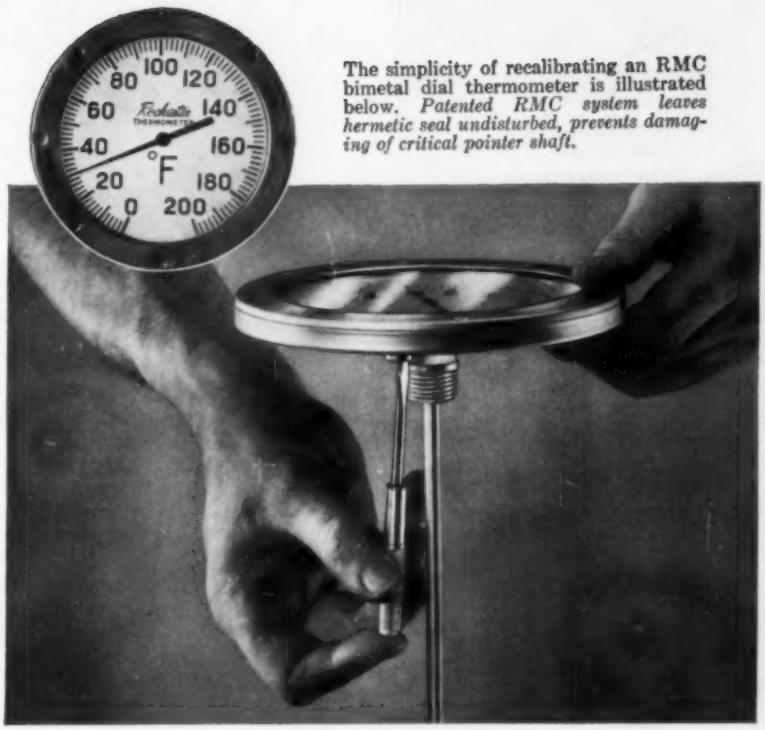
Marmor

Garlock appoints contract co-ordinator

James Marmor recently became contract co-ordinator of the Military Products Dept., Marketing Division, Garlock Packing Co., Palmyra, N. Y. Marmor was formerly with the Missile and Space Division, Lockheed Aviation, where he was technical co-ordinator for the Polaris program. He will be based in Palo Alto and will be responsible for military contract accounts west of Salt Lake City.

Representative for Dalmo Victor

Dalmo Victor Co., Division of Textron, Inc., Belmont, Calif., has appointed William C. Koenig their representative in Dayton, Ohio. Koenig, who heads W. C. Koenig and Associates, Inc., previously served as field representative for Dalmo Victor from 1951 to 1956, when he started his own firm of consulting engineers. Although his firm will continue to specialize in consulting engineering, Koenig will personally represent Dalmo Victor.



The simplicity of recalibrating an RMC bimetal dial thermometer is illustrated below. *Patented RMC system leaves hermetic seal undisturbed, prevents damaging of critical pointer shaft.*

RMC external recalibration device saves time and your thermometer

With the patented RMC dial reset screw you can recalibrate your thermometer easily and safely, should it ever be necessary. The all-important hermetic seal cannot be destroyed, and there is no chance for damage to the critical pointer shaft.

What the RMC system of recalibration means to you

Sometimes it is necessary to recalibrate industrial thermometers due to severe shock from rough handling, or to calibrate for extreme accuracy at any point on the scale for special work range.

Various recalibration systems are employed in the different makes of ordinary bimetal thermometers. Most all of them will achieve the desired recalibration, but a number of undesirable things may also result. In some, all semblance of air-tight seal is automatically destroyed in removal of the dial glass. In others, the critical pointer shaft may become bent or twisted. And still others use a mechanism incapable of holding the new setting for any length of time. *None of these things can possibly happen with RMC's patented recalibration device.*

A simple dial-reset screw, located on the back side of RMC thermometers, permits recalibration without opening the instrument in any way—thus leaving its air-tight hermetic seal intact. Its positive meshed-gear mechanism rotates the dial itself in a way that cannot under any circumstances cause damage to the pointer shaft. And the new setting will hold indefinitely.

Write, wire or phone for general catalog. If yours is a special application, tell us your requirements—RMC engineers will work with you in solving it. Rochester Manufacturing Co., 204 Rockwood St., Rochester 10, N. Y. (Telephone: BRowning 1-2020).

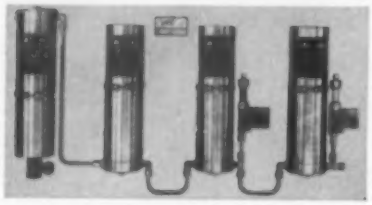
RMC

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

ROCHESTER MANUFACTURING CO., INC., Rochester, N.Y.

Circle **118** on Time-Saver Card

When water or oil in gases cannot be tolerated . . .



INSTALL ROBBINS

dehydration

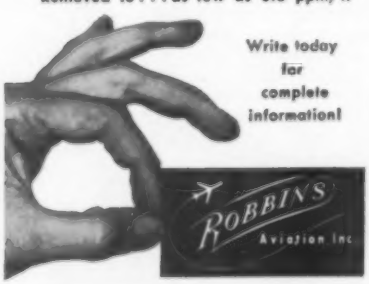
equipment

Robbins Aviation offers you both disposable cartridge type and refrigeration type dehydration systems for practically all types of gases . . . equipment designed and built to rigid quality control standards to give you maximum satisfaction in efficient trouble-free performance.

Robbins equipment is used extensively for aircraft pneumatic systems, test laboratory equipment, mobile compressor trailers, hydraulic system purging, missile charging and pressurizing systems, for instrument, laboratory, and factory air, controlled atmospheres for brazing and heat-treating furnaces, etc. Mechanical filters, drier and purifier chambers, refillable and disposable cartridges, dewpoint indicators also available.

Fast, positive, economical removal of water or oil vapor and impurities

Pressures to	12,000 PSI
Safety Factor	4 to 1
Dewpoints to	−100°F
Oil Vapor Removed to . . . as low as	0.3 ppm/w



Write today for complete information!

Manufacturers of high quality valves and dehydration equipment

2350 E. 38th St., Los Angeles 58, Calif.
LUdlow 9-5221

Circle **116** on Time-Saver Card

AIRCRAFT COMPONENT DATA

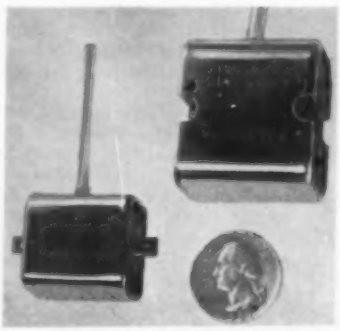
Absolute Pressure Relief Valve . . . controls airflow

Maintains pressure in instrument compartment to specified value. Single-stage, directly operated, has balanced poppet and aneroid bellows. Mounted inside compartment on wall in any position. Regulates pressure to ±0.25 psi from sea level to space at constant nominal flow of 8 scfm. Other valves in series cover wide range of outlet pressures and flow capacities. 0.025-psi shift for each *g* in direction of the major axis. 0.3-psi shift for 1 atmosphere change in ambient. Weight is 0.3 lb. P/N 26000.—*Aerodyne Controls Corp., Huntington Station, N. Y.*

Circle **500** on Time-Saver Card

Torque Motors . . . have flat armatures

Pole pieces, magnets, and armature completely contained and affixed to nonmagnetic, stainless-steel frame. Pole pieces or magnets can't shift position or break away from assembly in shock or vibration. Model 20 Series motors

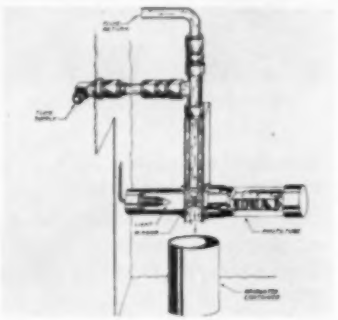


actuate control spools in electrohydraulic, electropneumatic, and hot gas servosystems. Four models. Strokes from ± .006″ to ± .015″. Output radii from .650 to .906. Midposition force from 2.5 to 13.0 lb. Hysteresis is 2%. Resonant frequency from 940 to 400 cps. Require from 1.6 to 5.2 w. Weigh from 2.8 to 18.5 lb.—*Servotronics, Inc., Buffalo, N. Y.*

Circle **501** on Time-Saver Card

Fluid Particle Counter . . . measures according to size

Fluid being tested is pumped directly through counter. Sample flows past a window where foreign



particles pass one-by-one. A light beam through window and fluid stream inpinges on a phorosensitive element on opposite side of stream. Particles interrupt light beam causing change in output signal from photosensitive element proportional to particle size. Counter curcuits record particles according to size. Calibrated with transparent disc containing particles of known sizes. For factory, laboratory, or field use.—*High Accuracy Products Corp., Claremont, Calif.*

Circle **502** on Time-Saver Card

High-Pressure Air Bottles . . . store gases & liquids

Manufactured from continuous windings of glass fiber, impregnated with epoxy resin. Light, strong, corrosion-resistant, safe. Normally spherical. To 50% weight savings over steel containers

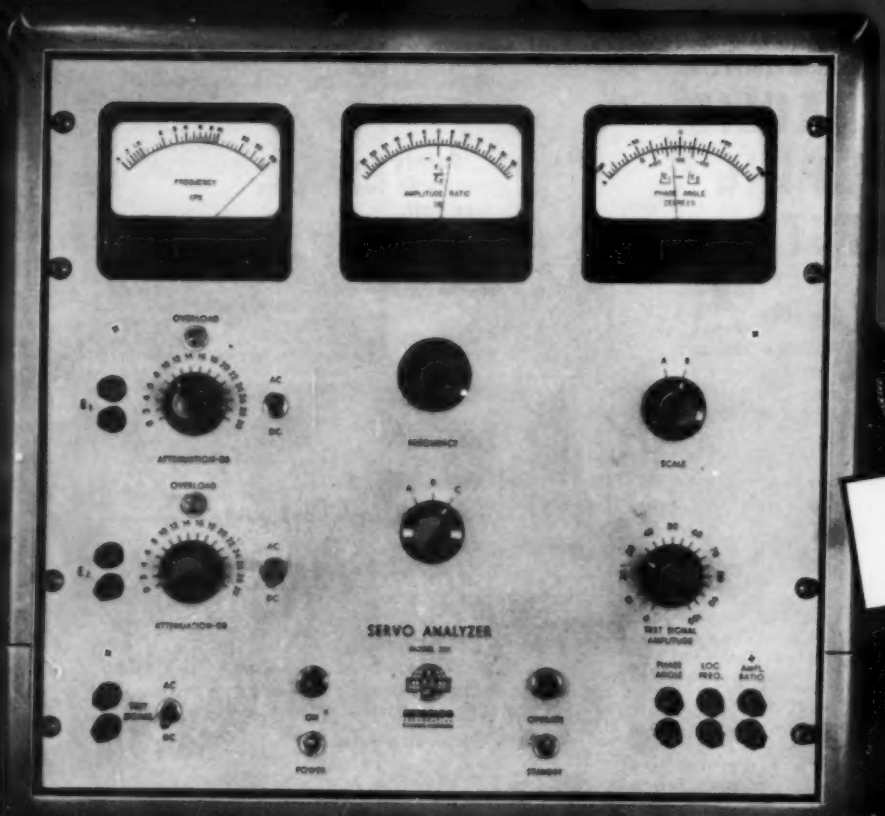
Continued on page 118

METROLOG 200

SERVO ANALYZER

AUTOMATICALLY.... PLOTS/READS

TRANSFER FUNCTIONS



INVITES COMPARISON

A **NEW** CONCEPT IN SERVO TEST EQUIPMENT

THE METROLOG 200 SERIES SERVO ANALYZERS REPRESENT THE ULTIMATE IN SERVO TEST EQUIPMENT.

Completely reduces transfer function data and presents it in the most useable form.

Simultaneously measures PHASE Relationship and AMPLITUDE RATIO of any two desired signals.

Instantaneously displays data, even at frequencies as low as 0.5 CPS.

In conjunction with two-axis recorder, automatically produces BODE PLOTS and NICHOLS CHARTS.

Generates tests signals and accepts input signals in any combination of AC or DC.

Establishes TRANSFER FUNCTION of complete system, individual sections or specific components under OPEN LOOP or CLOSED LOOP conditions.

WRITE TODAY FOR COMPLETE TECHNICAL INFORMATION

METROLOG CORPORATION

169 NO. HALSTEAD STREET

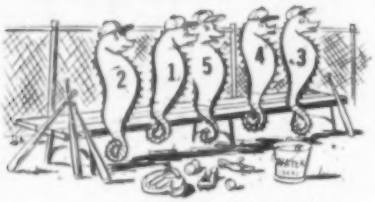
PASADENA, CALIFORNIA

A SUBSIDIARY OF AIR LOGISTICS CORPORATION

REPRESENTATIVES IN ALL PRINCIPAL CITIES

it takes a . . .

"STRONG BENCH"



. . . to produce the

EXTRA QUALITY* *you get in* **PAUL-MUNROE**

HYDRAULIC PUMPING UNITS

Paul-Munroe pumping units are rugged and trouble-free. The EXTRA QUALITY of the components we use is your best guarantee of dependable service. For example, consider the following:*

*** (1) DOWTY**

HYDRAULIC PUMPS • Offered by Berry Hydraulics, this British designed pump has an exclusive journal bearing feature that provides extra-long life and unique wear compensating ability. Range to 3000 p.s.i. and to 60 g.p.m.

*** (2) REULAND**

ELECTRIC MOTORS • With Reuland's spline-coupled hydraulic pump mount motor, the pump shaft is connected directly to the motor's shaft inside the motor. This cuts space needs 50%, assures perfect alignment and provides smooth, quiet operation.

*** (3) PAUL-MUNROE**

MANUFACTURING • You get guaranteed performance when you specify Paul-Munroe pumping units. The hundreds of installations now in use provide the best demonstration of our expert craftsmanship.

To order or for additional information wire, write, or phone . . .

PAUL-MUNROE
HYDRAULICS

6430 East Gage Avenue, Bell Gardens, California
Telephone: Los Angeles SPruce 3-2870

Circle **105** on Time-Saver Card

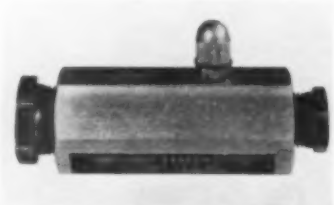
AIRCRAFT COMPONENT DATA

for equal volume and pressure capacity. No volumetric restrictions. Bottles fabricated for any number of cycles from 1000 to 10,000,000. From 100 to 5000-psi operating pressure.—*Apex Reinforced Plastics Div., White Sewing Machine Corp., Cleveland, Ohio.*

Circle **503** on Time-Saver Card

Hydraulic Safety Lock . . . supports load during line failure

Pilot check valve is for high pressure systems. Installed at cylinder inlet. Normally allows full

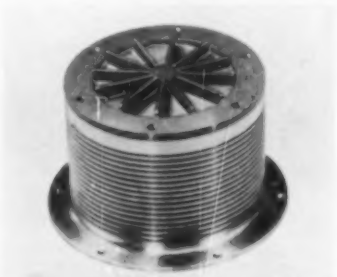


continuous flow to and from cylinder. If line or hose breaks, lock closes immediately and traps fluid in cylinder. Load remains supported or can be lowered by turning set screw which relieves pressure inside lock.—*Ground Systems, Inc., El Monte, Calif.*

Circle **504** on Time-Saver Card

Pressure Equalizer . . . for expansion chamber

Use with LOX and other fluid tanks where there is a pressure differential. Has machined aluminum



bellows which is hermetically sealed. Takes ¾" minimum stroke at 70 psi. Temperature range from —400 F to 750 F. Controlled wall thickness concentrates strength where needed. For pressures to 4000 psi. Sizes from ¼" to 36" diameter.—*Hydrodyne Corp., North Hollywood, Calif.*

Circle **505** on Time-Saver Card

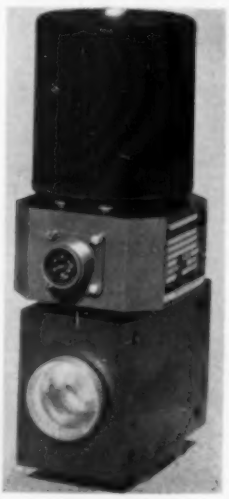
Valve Check-Off Chart . . . shows valve types & uses

Describes off-the-shelf valves. For aircraft, missiles, rockets, and GSE. Types are drain, bleed, check, system checkout, filler, fill and bleed, gage protector, relief, selector, shuttle, vacuum breaker, vent and breather, and float-actuated vent. Chart has O-ring recommendations.—*James, Pond & Clark, Inc., Pasadena, Calif.*

Circle **506** on Time-Saver Card

Shutoff Valve . . . has 3000-psi operating pressure

Employs rotary shear seal principle. Can be actuated by motor, solenoid, or hydraulic or pneumatic energy. Flow can be posi-



tioned from zero to 10 gpm. Controls fluids or gases. Pressure drop is 10 psi max at full flow. Low actuation torque. Zero leakage. Ports meet AND 10050-16.—*Vinson Engineering & Sales Co., Van Nuys, Calif.*

Circle **507** on Time-Saver Card

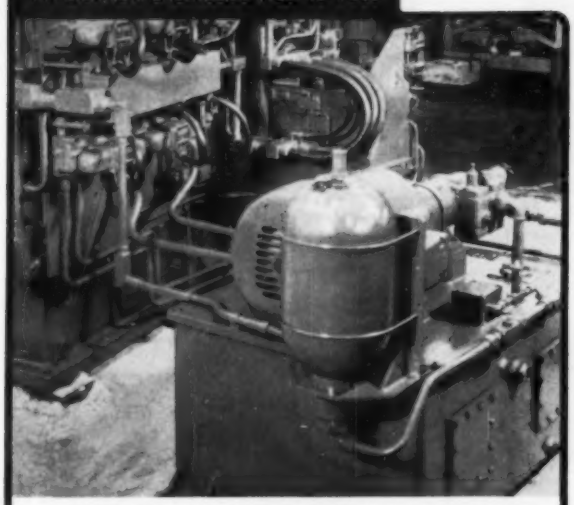
Thrust Reverser Pump . . . spur gear design

Hydraulic power source for activating jet engine thrust reverser. RR16340 is engine driven. Combines light weight, ease of overhaul. Has internal check valve, in-

Continued on page 120

Circle **54** on Time-Saver Card

APPLICATION ENGINEER'S FILE NO. P261



ACCUMULATORS TO HOLD PRESSURE

Band Saw Milling Machines made by Fitchburg Engineering Company incorporate a 2½ gallon Greer hydro-pneumatic bladder-type accumulator in the clamping circuit to hold hydraulic pressure and improve operation. Here as in numerous other applications Greer accumulators are specified to obtain maximum reliability and longer trouble-free operation. On your next fluid system design problem, be sure to contact a Greer factory representative or your local Greer distributor.

GREER HYDRAULICS INC.
4474 East Olympic Boulevard, Los Angeles 23, California
496 Grand Blvd., Westbury, L.I., N.Y.

new Tape-Seal®

seals hydraulic fittings 7 ways better, faster!

Not just another sealing compound! Tape-Seal, made from Du Pont's miracle Teflon®, *wraps* around connection . . . gives you these 7 important advantages:

Faster, easier to apply . . . wrap around connection, tear off, that's all ■ Never hardens . . . disassemble with ease, anytime ■ Completely insoluble and inert to chemicals, alkalies, and acids ■ Seals both threaded and flared joints. Ideal for packing ■ Unaffected by temperatures −250° to +500° F ■ Lubricates as it seals . . . completely eliminates thread-galling even on stainless steel ■ Withstands high pressures and vibration ■ In widths of ½", ¾", 1", 4" and wider.

▶ **Send for free sample!**

FRIESLAND PLASTICS COMPANY
Friesland, Wisconsin

Circle **45** on Time-Saver Card

3 CLASSES

OF PRESSURE GAUGES meet all service demands

1.

◀ ASHCROFT DURAGAUGES. The finest pressure gauges built—highest in sustained accuracy and durability. Ideal for the toughest services. Save many times their initial cost in replacements and repairs.

2.

ASHCROFT QUALITY ▶ GAUGES. Tops in general-purpose gauges — second only to the Duragauge. Available for pressure, vacuum or compound services in low, medium, and high ranges.

3.

◀ ASHCROFT STEEL CASE GAUGES. None better for small equipment like portable compressors, pumps, and for less important pressure lines. Pressure, vacuum, and compound ranges available.

Ashcroft dial sizes range from 2" through 24" . . . pressures from 30" vacuum or a few ounces up to 100,000 psi . . . materials to suit the application. Among the many Ashcroft Gauges are Maxisafe®, pneumatic receiver, recording, chemical, special purpose types, and various gauge testers. Invest wisely. Make your selection precisely for the job. Chose from the complete line of Ashcroft Gauges. Write for Catalog 300 B.

ASHCROFT PRESSURE GAUGES
A product of
MANNING, MAXWELL & MOORE, INC.

Gauge and Instrument Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ont.

Circle **85** on Time-Saver Card

HYDROMOBILE

THIS MAY NOT BE THE ANSWER TO OUR CROWDED HIGHWAYS (IT IS INJURIOUS TO NONSWIMMERS) BUT WE CAN GIVE YOU SOME UNWATERED ANSWERS ABOUT THINGS HYDRAULIC. CALL, WE'LL TALK!!!!!!

UNIVERSAL HYDRAULICS

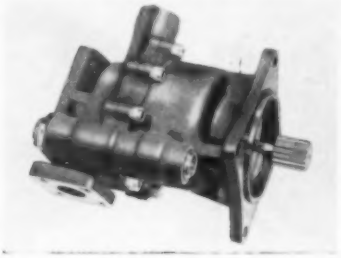
DIVISION OF HOLAN CORPORATION

P. O. BOX 4500
CLEVELAND 24, OHIO
WHITEHALL 2-4595

Circle **131** on Time-Saver Card

AIRCRAFT COMPONENT DATA

ternal bypass valve. Capacity from 2.7 to 3.1 gpm at 300 F, inlet pressure 25 to 30 in. Hg abs, 2800 rpm, 500 psi discharge. Maximum capacity, 6.0 gpm at 3800 rpm and



200 psi discharge pressure. 1.8 hp maximum power requirement. Weight is 8.5 lb. Mounting pads available to AND specifications or as specified.—*Lear, Inc., Lear-Romec Division, Elyria, Ohio.*

Circle **508** on Time-Saver Card

Size Gage For O-Rings . . . checks cross-section, ID

Measure cross-section with slots in base. Put ring on cone. Read off ARP (AN) sizes from cone.—*Parker Seal Co., Div. Parker-Hannifin Corp., Culver City, Calif.*

Circle **509** on Time-Saver Card

Pressure Regulators & Check Valves . . . for gases & liquids

Hand-control, electric-control, and dome-loader regulators. Working pressures to 10,000 psi. Vent automatically on reducing pressures. Handle torque is 12 in-lb. Bubble-tight. Check valves for 50 to 15,000 psi. ¼" to 1½" ports. Orifices ¼", 5/16", ½", ⅝".—*Specialty Engineering Co., San Gabriel, Calif.*

Circle **510** on Time-Saver Card

Teflon Hose Assemblies . . . have swaged fittings

Extended impulse test life is 250,000 cycles. Characteristic of fitting matches properties of hose material. No inherently weak points in assembly. Lighter than assemblies with screwed-together fittings. All sizes from —4 to —12 meet SAE. ARP 604 specifications. For 3000 psi. —67 to 400 F.—*Resistoflex Corp., Roseland N. J.*

Circle **511** on Time-Saver Card

Aircraft Tubing . . . specification chart

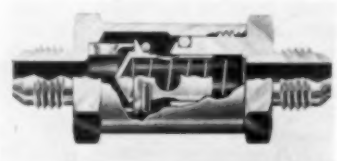
Information on steel tubing in concise chart form. Lists MIL-T and superseded MIL-T specifications in comparison with AMS specifica-

tions. One column lists major differences between the two types. For each specification the tensile strength and elongation is given. Other columns list the condition of the steel and the principal applications. Types 304 and 347 tubing are for hydraulic and pneumatic systems.—*Tube Distributors Co., Garden City, N. Y.*

Circle **512** on Time-Saver Card

Automatic Drain Valve . . . Teflon or Viton A seals

Normally open check valve closes at preset pressure or flow. Opens to bleed fluid at pressures below system operating pressure. P-526



valves of aluminum or stainless steel. For pressures to 3000 psi. Operates from —65 F to 500 F. For fuel, air, nitrogen, LOX.—*James, Pond & Clark, Inc., Pasadena, Calif.*

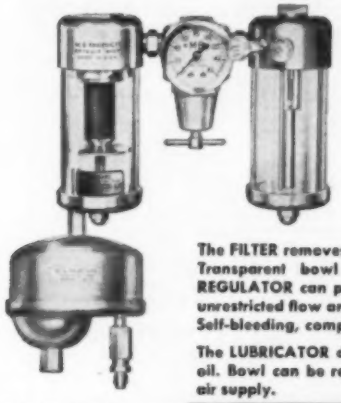
Circle **513** on Time-Saver Card

Circle **62** on Time-Saver Card

GREATER PROTECTION to your AIR LINE!

M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M-B PRODUCTS
46 VICTOR AVE., Div. 12
DETROIT 3, MICHIGAN

HYDRAULIC ENGINEERING FOR INDUSTRY

CARDWELL

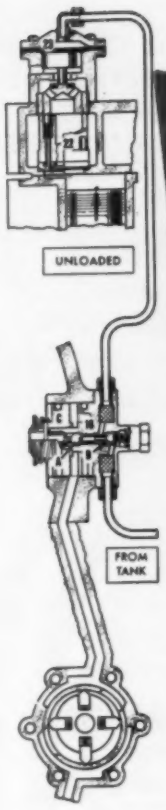
TRADEMARK SINCE 1829

DESIGN SERVICES
FABRICATION
POWER UNITS
HYDRAULIC PANELS
ELECTRICAL CONTROL PANELS
ACCUMULATORS
STOCKING DISTRIBUTORS
HYDRAULIC COMPONENTS

Complete Engineering and Design Services Are Available. Qualified Sales and Service Engineers in Most Areas.

The CARDWELL MACHINE COMPANY
A CARDWELL TRADITION SINCE 1829
Franklin at 19th St. Richmond 11, Virginia • Phone MIlton 4-4593

Circle **28** on Time-Saver Card



loadless starting

ANOTHER BIG REASON TO THINK ABOUT

Quincy COMPRESSORS

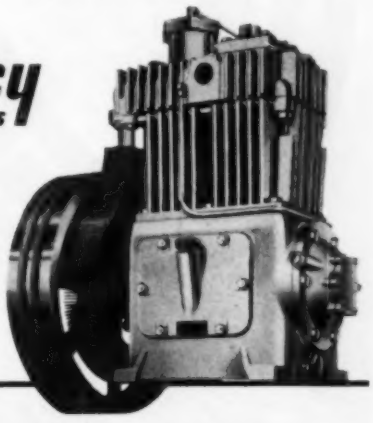
LOADLESS STARTING is an exclusive, patented QUINCY feature that eliminates a compressor starting load at all times. Loadless starting also puts an end to noisy and troublesome check valves. This outstanding design feature is recommended for automatic start and stop units.

Other QUINCY features that add up to constant efficiency and long life are Safe-Q-Lube pressure lubrication, Lynite connecting rods, perfectly balanced crankshaft, automotive type pistons, cushioned steel valves and large oversize Timken tapered bearings.

In all ways — from installation to years of reliable service — investment in a QUINCY repays itself best.

Quincy COMPRESSORS

CHECK THE 1960 "Q-LINE" NOW — a complete range of compressor models for all types of industrial applications.



QUINCY COMPRESSOR CO., Quincy, Illinois
Makers of the World's Finest Air Compressors

Circle **110** on Time-Saver Card

FOR CUSTOM COMPOUNDED PRECISION FABRICATED

Go Goshen RUBBER PARTS SEALS PRODUCTS

O-RINGS

TO MEET ADVANCED REQUIREMENTS

Capitalize on Goshen's experience in serving the needs of hundreds of large and small users of o-rings in the United States and Canada. Precise control of quality thru every stage of formulation and manufacture is the key to an outstanding record of sealing success.

GRC o-rings in all standard AN, MS, SAE and JIC sizes, in many non-standard sizes and in special sizes, are available from established and proven synthetic and silicone specification compounds. Go Goshen for efficient sealing under most any given conditions.

Ask for your free copy of 16-page O-ring Brochure on size, groove dimensions, compounds and other helpful information.

Goshen Rubber Co., INC.

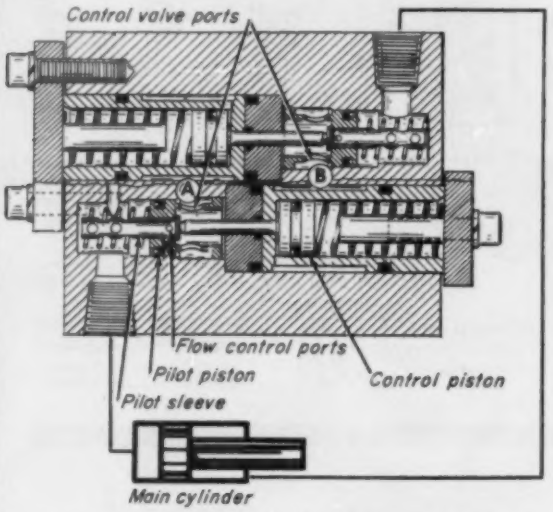
1360 S. TENTH ST. • GOSHEN, INDIANA

Circle 51 on Time-Saver Card

FLUID POWER PATENTS

Cylinder Lock Valve

This valve has three functions. It locks a cylinder in place when the directional control valve is centered, it relieves to tank if cylinder pressure gets too high, and it varies fluid flow with pressure. The valve mounts in the circuit between the control valve and the cylinder.



• **Operation**—When the directional control valve shifts and applies pressure to port *A*, fluid flows into the annular area around the hollow top control piston. It then flows through the port in piston wall to the rod end of the control piston. The piston retracts and its rod end moves off its seat in the pilot sleeve. Fluid from the rod end of the main cylinder flows through the pilot sleeve and out port *B* to tank.

Fluid extending the main cylinder flows from port *A* into the lower pilot section of the valve. The pilot piston moves left and opens ports in the pilot sleeve. Fluid then flows through these ports to the head end of the main cylinder. As pressure increases, the pilot piston moves further left and opens more control ports, increasing flow to the head end of the main cylinder.

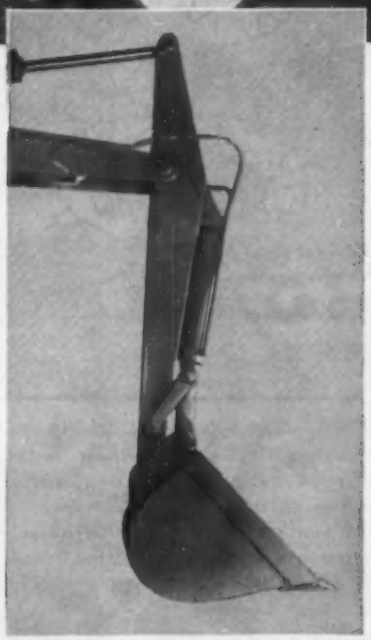
If pressure to the head end of the main cylinder increases enough to overcome the force of the control piston spring, the lower pilot sleeve moves right and its flow control port opens, relieving the pressure.

U. S. Patent No. 2,872,903 by David M. Richey, assigned to Emhart Mfg. Co., Hartford, Conn.

Hydraulic Pump-Motor Drive

The assembly consists of a gear pump and a gear motor in a single casing. Output speed is varied by

Continued on page 124



Hydraulic Machinery Company, Waukesha, Wisconsin, are designers and manufacturers of the HY-HOE. Republic ELECTRUNITE Special Smooth I.D. Hydraulic Cylinder Tubing is used in the assembly of the hydraulic cylinders.

HY-HOE...HIGH PERFORMANCE with REPUBLIC ELECTRUNITE

SPECIAL SMOOTH I. D. HYDRAULIC CYLINDER TUBING

"Eliminated all problems of machining and scrap loss"... was the report from Hydraulic Machinery Company, Waukesha, Wisconsin, leaders in the manufacture of hydraulic equipment.

Republic ELECTRUNITE® Special Smooth I.D. Hydraulic Cylinder Tubing is used in the assembly of the eight hydraulic cylinders of the HY-HOE, an all-hydraulic back hoe with a ⅜ cubic yard capacity. This unit can be mounted on the back of a carrier or truck chassis for easy maneuverability. Rotates 360°.

ELECTRUNITE Special Smooth I.D. Hydraulic Cylinder Tubing reduces costly and time-consuming machining because uniformity is built-in. Uniform wall thickness, strength, diameter, ductility assure predictable, dependable physical characteristics.

ELECTRUNITE Special Smooth I.D. Hydraulic Cylinder Tubing is available in sizes from 1" through 4½", and up to .187" wall thickness. Call your Republic representative, or send coupon.

REPUBLIC STEEL

STEEL AND TUBES DIVISION

REPUBLIC STEEL

Cleveland 8, Ohio

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • DEPT. C-9634
211 EAST 131st STREET • CLEVELAND 8, OHIO

Please tell me more about Republic ELECTRUNITE® Hydraulic Cylinder Tubing.

Name _____ Title _____

Firm _____

Address _____

City _____ Zone _____ State _____

Circle **114** on Time-Saver Card

new

airmatic

Air-Operated "C" Clamp

SIMPLIFY CLAMPING JOBS —SPEED PRODUCTION

You'll get the right amount of pressure, every time, whatever the clamping operation—with this new Airmatic Air-Operated "C" Clamp. And you'll find dozens of applications in every department of your plant or shop—for this and the many other Airmatic Clamping Cylinders—that assure accuracy and speed production.

Our quality is tops. Our deliveries are prompt. Our prices are right. Our engineering services are yours for the asking.

Write for our latest catalog CC-3000

AX-26

AIRMATIC VALVE, INC.
7313 Associate Ave., Cleveland 9, Ohio

Phone: WOodbine 1-5320 · WESTERN UNION: Airmatic Valve-Inc. FAX: Cleveland, Ohio

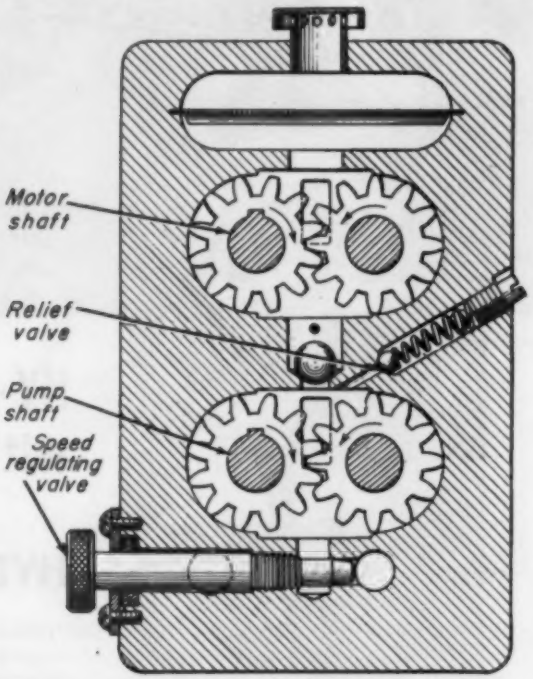
Circle 4 on Time-Saver Card

FLUID POWER PATENTS

throttling fluid to the pump. The casing serves as a reservoir. Fluid level is maintained above the top of the pump gears.

• **Operation**—A prime mover rotates the pump gears at constant speed. Fluid is pumped through the check valve to the fluid motor. Discharge from the fluid motor passes through a port at the top and returns to the reservoir.

As the speed regulating valve is closed, less fluid enters the pump. This reduces fluid to the motor and



slows it down. The check valve holds fluid in the motor, thus preventing its becoming vapor bound. A spring-loaded relief valve prevents overloading the drive motor.

When pump and motor gears are the same size, maximum output speed is equal to input speed. By changing size of the gears, maximum output speed can be increased or decreased.

U. S. Patent No. 2,849,863 by John Dubrovin, assigned to W. M. Welch Mfg. Co., Chicago, Ill.

Other Patents Issued

MULTIPLE-POSITION VALVE

No. 2,910,089 by Gordon W. Yarber, Cornell, Calif.

VARIABLE-CAPACITY PUMP

No. 2,907,297 by Emil J. Carlton, assigned to Hydraulic Engineering Co., West Springfield, Mass.

PISTON PUMP

No. 2,909,123 by Harry C. Jennings, assigned to Everest and Jennings, Inc., Los Angeles, Calif.

Circle **56** on Time-Saver Card

I Told You to order Permaseal!

IT PROBABLY DOESN'T GET THIS BAD . . . but we do know that anyone who has used Grover Permaseal Hydraulic Piston Rings is tempted to react like our friend here if he has to use a substitute.

If you aren't now using Permaseal we suggest you write for Engineering Bulletin 1259 (sample ring included) and find out first-hand why *"There's Permanency in Permaseal"*.

Rings manufactured to your specifications. Stock sizes: 1⅜" through 10" O.D.

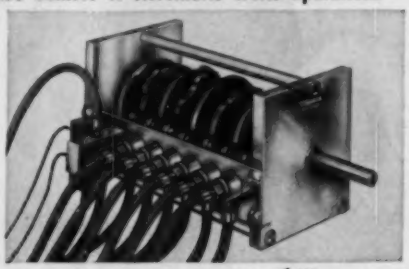
grover
piston ring co., inc.
129 N. BROADWAY, MILWAUKEE 2, WIS.

ENGINEERING AND DESIGN SERVICE AVAILABLE

Circle **31** on Time-Saver Card

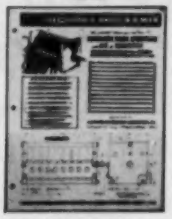
NEW STURDY, PNEUMATIC — ELECTRICAL
SEQUENCE PROGRAMER
for Precise Control of Automatic Work Operations

PRECISION BUILT . . .
Reasonably PRICED . . .
Immediate DELIVERY!



Now — a rugged, dependable, inexpensive pneumatic-electrical sequence programing unit for precise control of your automatic tooling and work operations! Overall size 7⅛" x 3¾" x 4". End plates tapped for mounting bottom or rear. Self-lubricating bearings. ⅜" steel shaft may be extended out either or both ends for tandem operation. Selection of any combination of 8 standard long-life, easily machined single piece phenolic cams fills majority of requirements. Special cams available at nominal cost. For millions MORE cycles of trouble-free service life and simplest maintenance, use with Clippard MINIMATIC VALVES and CAM FOLLOWERS as shown above.

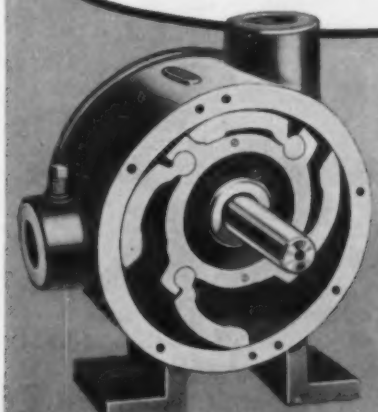
Clippard Minimatics



Write, NOW, for FREE BULLETIN No. 360

Clippard INSTRUMENT LABORATORY, INC.
7386 Colerain Rd., Cincinnati 39, O. Phone JAckson 1-4261
Manufacturers of Precision Pneumatic Devices, R. F. Coils, Electronic Equipment

Here's why LEIMAN AIR PUMPS
Put "Lifetime" Dependability into your Machines!



HINGED, CURVED VANES OF DURABLE CAST IRON
Take up their own wear

Four curved vanes on easy-action hinges scoop up large volumes of air and maintain perfect cylinder wall contact by centrifugal force. Vanes and cylinders are made of durable cast iron (no composition). They hone themselves to hard, glassy smoothness, reducing frictional wear to a minimum. Negligible wear is automatically taken up by rotating vanes. 2 to 3 times more air space is provided.

Typical reports from users:

"Never wear out or give trouble"
"Used 350 pumps without a complaint"
"Pumping 24 hours a day for 21 years"
"12 years without any attention, except lubrication"

•

If the operation of your machines depends on a reliable, steady source of vacuum (suction) or air pressure—install Leiman Air Pumps. They will last for the life of your equipment—providing fully-rated capacity, year after year, with little or no maintenance.

The simplified design of Leiman Air Pumps has fewer moving parts—provides greater capacity in smaller pumps to compact your designs. Airflow is smooth—operation extremely quiet. A wide range of models and sizes is available to meet your operating conditions. Experienced engineers are at your service on any design or installation problem.

LEIMAN BROS., INC.
151 Christie St., Newark 5, N. J.
Established 1887

SEE OUR CATALOG IN SWEET'S FILE

Write for new catalog showing construction, types, sizes and specifications, plus Application Book containing many "how-to-do-it" blueprints.

LEIMAN Rotary Positive **AIR PUMPS**
Vacuum to 29.9 Hg. Pressure to 20 p.s.i.g. Volume to 162 c.f.m.

CREATIVE ENGINEERING

is a better buy than lost time on the assembly line!

BEFORE you go into production is the time to let a Precision Sales Engineer analyze your problems, recommend solutions. As a recognized "O" Ring specialist, his knowledge and skill can help you improve product operation, simplify design, reduce assembly costs and eliminate early product failure. He'll help you obtain the right product design, then recommend the right "O" ring for the job. Precision "O" Rings are rigidly inspected, true to size and meet all military and commercial specifications.
Be safe with Precision. Write, phone, or wire for the services of a Precision Engineer today.

BE SAFE WITH **PRECISION**

Precision Rubber Products Corporation • "O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 7, Ohio Canadian plant at: Ste. Thérèse de Blainville, Québec

Circle **108** on Time-Saver Card

NEW PRODUCTS

Continued from page 56

AIR VALVE
. . . for on-off control

Features: Controls clamp-type and other single-acting, spring-return

cylinders. Compact for use in tight places. Installs in line, on cylinder, or on machine.

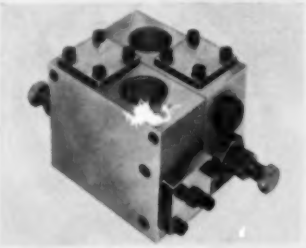
Foster Mfg. Co.
St. Louis, Mo.

Circle **309** on Time-Saver Card

HOLDING VALVES
. . . to 3000 psi at 20 gpm

Features: Locks cylinder or motor when necessary, and relieves excessive pressures, prevents load from exceeding fluid supply. Requires little power. Opens with pilot pressure assist of approximately 20% of difference between load-induced pressure and valve setting.

Specifications: Single models with external pilot and port. Double



models with internal pilot. Pressure drop 28 psi at 20 gpm. ¾" or 1" pipe ports. For 3000-psi service. 28-psi drop at 20 gpm.

Sarasota Precision Products, Inc.
Sarasota, Florida

Circle **310** on Time-Saver Card

Continued on page 128

Circle **123** on Time-Saver Card

Better Pumps

ECONOMICALLY PRICED

Cartridge Valving . . .

Simplified Servicing!

Here are hand operated, single acting pumps of near-aircraft quality for those better applications requiring long, trouble-free, economical service life. Cartridge valving. Conveniently located release valve. 1000, 2500 and 5000 psi operation. .9, .4 and .17 cu. in. per stroke. Standard reservoir (60 cu. in.) may be pressurized to 80 psi. Cartridge valves are easily serviced by removing "O" ring sealed plugs. SHEFFER precision quality thruout. Write for complete data.

$39.95 WRITE, NOW FOR BULLETIN NO. 160

THE SHEFFER CORPORATION

Cincinnati 15, Ohio
Phone POplar 1-8227

NFPA MEMBER

SOLD BY LEADING DISTRIBUTORS NATIONALLY

SEE PHONE BOOK YELLOW PAGES

Just Out! Just the ticket to cut cost!

ROSS CUB

NEW SPEED CONTROL VALVE

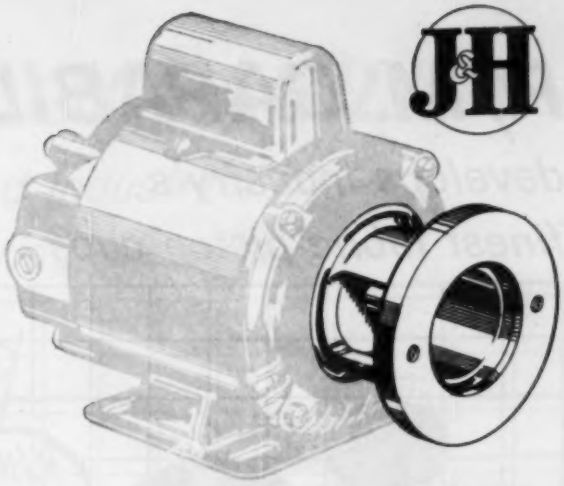
⅛" and ¼" pipe sizes in stock now!

Now a speed control valve that regulates your cylinder movement with precision and sureness, but which lists at $3.00 and $3.25. And despite its lower costs, "CUB" features the same high quality of design and workmanship you've come to expect from Ross. "CUB'S" design stresses trouble-free operation and easy maintenance. CUB is small, aluminum and lightweight. If you use speed controls, by all means call your Ross representative or write us.

ROSS OPERATING VALVE CO.

105 E. Golden Gate Ave. • Detroit 3, Michigan

Circle **120** on Time-Saver Card



Start here, go anywhere...

with new freedom of design in hydraulic pump application

Right at this coupling, there is a meeting of minds between pump designer and motor designer. Jack & Heintz can build the drive end to suit your individual requirements for mounting, alignment or coupling—just like that!

Change the flange length, flange diameter. Call for additional horsepower . . . higher ratings for intermittent duty. Make it more compact. Mount it upside down. Jack & Heintz can do it . . . can *customize* the perfect motor for your hydraulic pump application.

In fact, whatever your specs, Jack & Heintz can deliver a *smaller, lighter motor* than any conventional motor. And . . . eliminate all alignment problems!

Here's the "ball park"—

HORSEPOWER: ½ to 1½ single phase, ½ to 2 three phase
SPEEDS: 3450, 1725 or 1140 rpm
FRAME: J66 or special
ENCLOSURE: Open or totally enclosed, or special
BASE: Standard NEMA, or special
MOUNTING: Vertical, horizontal or special

Prompt quotation follows receipt of your inquiry. Write today: JACK & HEINTZ, 17620 Broadway, Cleveland 1, Ohio.

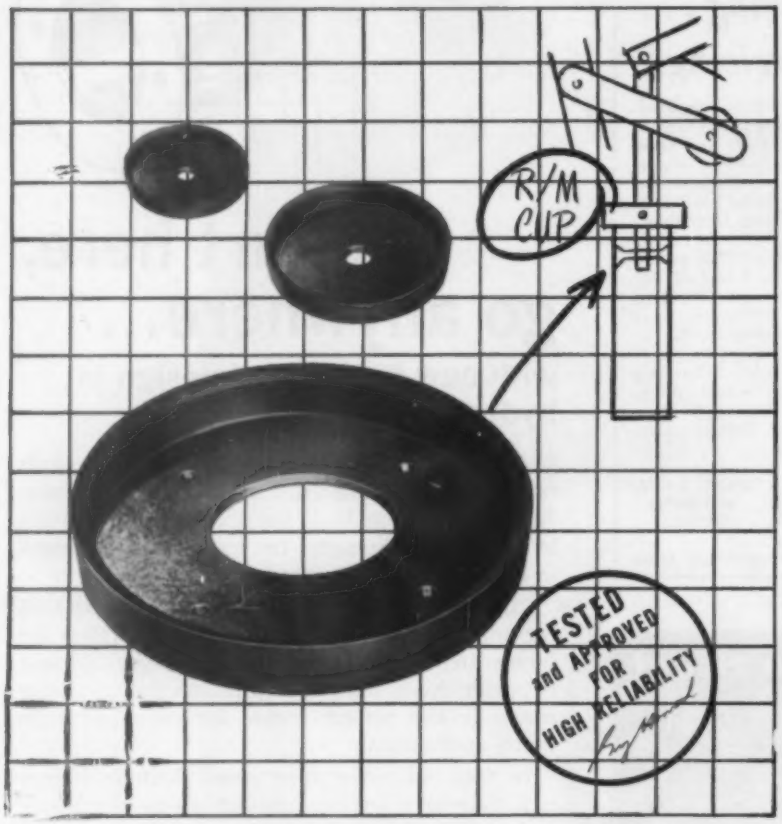
DESIGN YOUR PRODUCT TO DO A JOB—NOT TO FIT A MOTOR

Customized
JACK & HEINTZ
ELECTRIC MOTORS

Circle **70** on Time-Saver Card

R/M CAPABILITY

develops industry's finest fabric piston cups



R/M Fabric Piston Cups are all examples of R/M's high capability in the packing field and application of these skills to industry's growing demands. They are designed and precision molded for minimum friction and high resistance to extrusion. R/M chemists and engineers have developed a wide range of rubber synthetics with fabric reinforcements so as to provide materials to meet any requirement. Accurate and carefully controlled molding of the cups assures dimensional uniformity and maximum sealing efficiency.

R/M Fabric Piston Cups fit hydraulic and pneumatic cylinders ranging from ½ to 12 in. in diameter. They are molded in varying degrees of hardness to withstand pressures up to 1500 psi. When ordering, specify type of equipment, constant or intermittent service, type of fluid, temperature range, pressure and speed range.

For complete data, including service recommendations, write for R/M Mechanical Packings and Gasket Materials Bulletin No. P-210C. In it you will find R/M piston cups to suit your most exacting requirements.

R/M **PACKINGS**

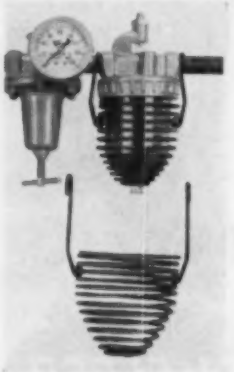
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N. J.
MECHANICAL PACKINGS AND GASKET MATERIALS

Circle **112** on Time-Saver Card

NEW PRODUCTS

PROTECTOR CAGE
. . . for plastic bowls

Features: When plastic bowls of pneumatic filters and regulators explode, cage restrains flying particles.



Moveable hooks attach to pipe.

Specifications: Three sizes fit bowl from ¼" to 1".

C. W. Morris Co.
Detroit, Mich.

Circle **311** on Time-Saver Card

4-PORT SELECTOR VALVE
. . . for dual system control

Designation: Model P2-418

Features: Rotate handle 90 deg. to actuate both valve components simultaneously. Reverses flow of two fluid systems through two alternate systems. O-rings precision-fitted into machined grooves. Plug

one port for 3-way operation. In aluminum or 303 stainless steel.

Specifications: Operates at temperatures from —40 to 350 F, depending on O-rings. Connections are ⅛" NPT.

Circle Seal Products Co., Inc.
Pasadena, Calif.

Circle **312** on Time-Saver Card

ELECTROHYDRAULIC SERVOVALVES
. . . weigh 5.12 oz

Designation: Series 30

Features: Work like Series 31 servovalves. Have same nozzle-flapper hydraulic amplifier and mechanical feedback arrangement. Aluminum body has small, second-stage spool and bushing. Industry standard mounting. For new jobs, smaller mounting feet available. Small feet permit drilling and tapping of manifolds now in use.

Specifications: Flow to 3 gpm at 3000 psi.

Moog Servocontrols, Inc.
East Aurora, N. Y.

Circle **313** on Time-Saver Card

HYDRAULIC POWER PUMPS
. . . for 10,000 psi

Designation: No. 1721 Series

Specifications: Four models develop continuous 10,000 psi. Pump 150 cipm at pressures to 150 psi. Automatic changeover to 30 cipm at pressures to 10,000 psi. Usable

oil volume is 260 cu. in. Motor can be started under load, while ram is held in position under pressure. Outlet block has two, ⅜"-NPT and pipe outlets. Self-contained, capacitor-type electric motor rated at ¾ hp, 115-230 vac. Speed is 1725 rpm. Single-phase.

Greenlee Tool Co.
Rockford, Illinois

Circle **314** on Time-Saver Card

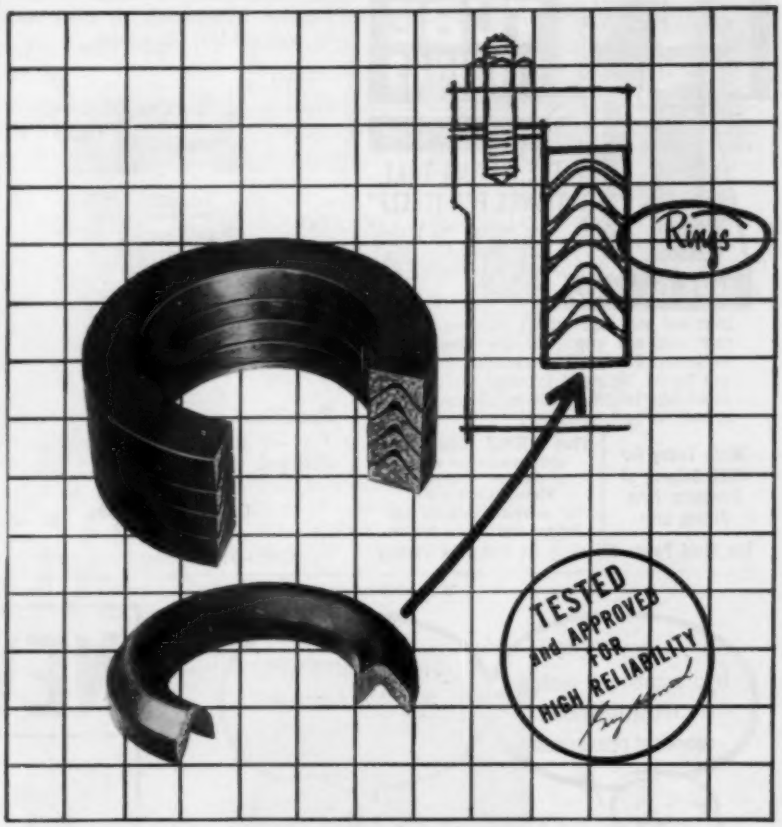
AIR CYLINDERS
. . . have 3 new mounts

Features: Angle bracket, side leg, and extended tie rod mounts. Line now has eight mountings. Cartridge-type bronze bearing has self-adjusting U-cup piston rod seal. Ground, hard-chrome-plated piston rods have minimum yield strength of 125,000 psi. Recessed cushion and adjusting

Continued on next page

R/M CAPABILITY

developed industry's finest V-ring—Vee-Flex®



Because of exceptional capability in the packing field, R/M is widely regarded as the surest source for the solution of difficult packing problems.

One example is development of R/M Vee-Flex. Self-sealing, self-adjusting, it is the *original* convex-design hydraulic V-ring. Its surface has a convex curvature where it contacts the ring adjacent. On the pressure stroke, an automatic flexing action occurs, producing a positive seal against the shaft and stuffing box wall, and against the next ring as well.

Deep, thorough penetration of the compound into the fabric of this quality packing enables it to provide maximum resistance to extrusion at high pressures. This, plus rock-hard adapter rings, makes it possible for Vee-Flex to withstand pressures in excess of 6000 psi without extruding. And the problem of wicking action is eliminated.

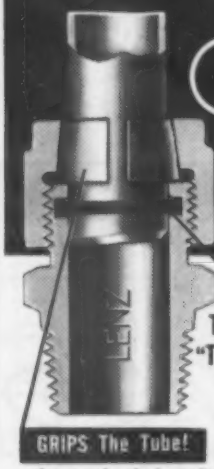
Specify tough, positive-sealing R/M Vee-Flex Packing for long, trouble-free service on all your piston and rod applications. For complete data, write for the R/M Vee-Flex Bulletin.

R/M **PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N. J.
MECHANICAL PACKINGS AND GASKET MATERIALS

Circle **113** on Time-Saver Card

Circle **79** on Time-Saver Card

Specify **LENZ** EXCLUSIVE O-RING SEAL J.I.C. APPROVED **TUBE FITTINGS**



SEALS The Tube!

THE FITTING THAT "THINKS FOR ITSELF"

The higher the pressure the tighter the seal . . . the stronger the grip!

GRIPS The Tube!

Lenz and only Lenz fittings give you separate seal and grip . . . fit any tube wall thickness. **ELIMINATES** weakening threads and flaring. No metal to metal seal . . . no exact tube length . . . cuts installation time in half! All parts re-usable!

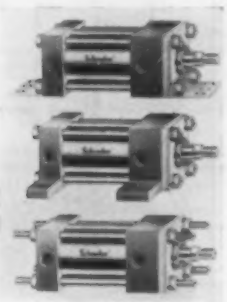
Write Today for FREE Catalog of Complete Tube Fitting Line

The LENZ Company
3307 Kiepinger Road
Dayton • Ohio
Phone: CR 7-9364
For Nearest Distributor See Thomas Register A-Z Section

See Fluid Power Directory for Complete Catalog

NEW PRODUCTS

screws. Cushions can be locked. Angle-bracket mounts on tie rods on any side of cylinder. Extended tie rod mounts give versatile mounting for front, back, or both ends in straight-line locations.



Specifications: 5 sizes to 4" bore. For air to 250 psi, hydraulic to 750 psi.

A. Schrader's Son
Div. Scovill Mfg. Co.
Brooklyn, N. Y.

Circle **315** on Time-Saver Card

PIPE TAPE DISPENSER . . . has quick-cutting edge

Features: Dispenser has cutting assembly with steel edge. Fits on clear plastic container which holds tape, ½" wide, to 567"-length roll.

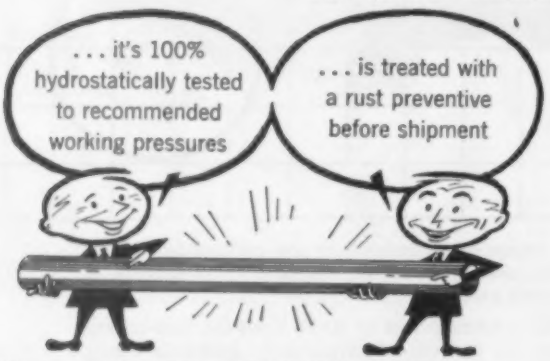
Dispenser is reuseable. Tape seals threaded connections under most difficult service conditions. Prevents seizing and galling, is self-lubricating, permits connections to be drawn to maximum tightness. Remains plastic so connections can be disassembled. Temperature range, —250 F to 500 F. Applied by wrapping around threads.

Crane Packing Co.
Morton Grove, Ill.

Circle **316** on Time-Saver Card

Continued on page 132

TubeXperience in action



Here are 8 more reasons why Superior (SAE) Hydraulic Steel Tubing is your best buy

- **Ease in bending and flaring,** with no loss of ductility in storage or service—by use of 0.12% max. carbon non-aging steel.
- **Consistently uniform tubing**—by careful inspection of raw material and tubing in process.
- **Bright scalefree OD and ID**—by controlled atmosphere annealing.
- **Smooth ID** by mandrel drawing close to finish size.
- **Assured cleanliness** by hot solvent degreasing before process anneals and shipment.
- **Flare-inspected quality** based on 35% increase of OD.
- **All tubing boxed and wrapped** for cleanliness and to protect against bending and denting during shipment or in warehouse storage.
- **Complete range of sizes** stocked and sold by leading steel "Service Centers."

SEND FOR YOUR COPY Bulletin 39, containing bending data, working and bursting pressures, and flow information. Handy reference material for your files. Write Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

Superior Tube
The big name in small tubing
NORRISTOWN, PA.

All analyses .010 in. to ½ in. OD—certain analyses in light walls up to 2½ in. OD
West Coast: Pacific Tube Co., Los Angeles, Calif. • FIRST STEEL TUBE MILL IN THE WEST

Circle **128** on Time-Saver Card

NEW

BIG SAVINGS Come in SMALL PACKAGES

MINI-REG®
AIR PRESSURE REGULATOR

COSTS *LESS* . . . LASTS *LONGER*
Outperforms Units *Twice* Its Size!

- **SET IT . . . FORGET IT!** Precision engineered assembly needs far fewer adjustments, maintains steady pressure up to 125 PSI!
- **STRETCHES REPLACEMENT SCHEDULES!** Mini-Reg lasts longer—*reduces* inventories, **cuts** replacement expense. And it works where others fail. ***Ends*** costly production stoppage due to overpressured lines!
- **CUTS COSTS, TIME, LABOR!** Mini-Reg ***costs less*** to buy, ***installs*** easier, ***saves*** man-hours by eliminating frequent adjustments.

Jarett "Your Gauge of Quality"
COMPRESSOR & EQUIPMENT, INC.
275 CENTRAL AVE., NEWARK, N. J. HU 5-8500
Patent No. Pending 2890713

Circle **72** on Time-Saver Card

Webster hydraulics raise production, lower costs

Two ton push-up! Second story operators like this powerful lift truck speed material handling and construction — save time, money. Thanks to hydraulics! Fingertip control raises the load, lowers it — tilts it forward or back. And a Webster Directional Control Valve channels the action. Deftly. Accurately.

Where space is at a premium — this versatile valve fits in. It's the smallest size for rating! Operating pressures range to 2000 psi, shock pressures to 5000 psi . . . with lowest back pressure. Inlet and outlet connections can be made from the same end to simplify hook up. And it's provided with alternate porting positions. Sizes from single spool to 6 spools; capacities from 20 to 40 gpm. Parallel design permits control of up to 6 independent circuits!

Build construction equipment? Machines for industry or agriculture? Keep this Webster Directional Control Valve in mind.

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

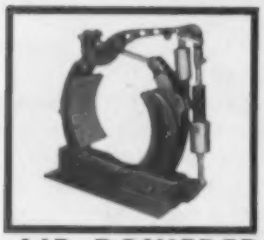
RACINE · WIS

STACK TYPE
DIRECTIONAL CONTROL VALVE
Bulletin HY 1 contains complete engineering data — installation, performance, specifications. Write for it!

Circle **135** on Time-Saver Card

STOP EQUIPMENT SAFELY

with Wagner



AIR POWERED or HYDRAULIC BRAKE SYSTEMS

Wagner makes both air powered and hydraulic industrial braking systems that stop your equipment safely, easily, economically.

WAGNER AIR POWERED BRAKING SYSTEMS use the same heavy-duty brakes that Wagner builds for hydraulically operated overhead crane brakes. Application is flexible . . . any number of brakes and control points may be used at reasonable distances from each other.

WAGNER HYDRAULIC BRAKE SYSTEMS let you put the *right* braking system on your large or small cranes. Example: new 6" x 3" size brakes are perfect for floor-operated or small cab-operated cranes.

Let your nearby Wagner Sales Engineer help you select the braking system best suited to your needs. Call him today.

W160-4

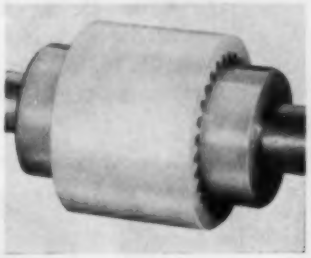
Wagner Electric Corporation

6387 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

NEW PRODUCTS

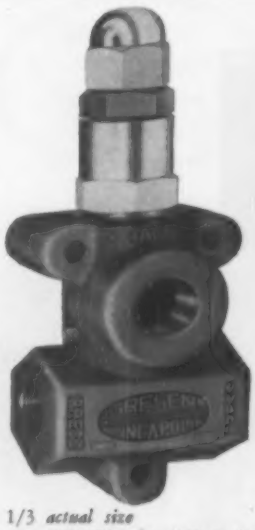
NYLON SHAFT COUPLINGS . . . need no lubrication

Designation: Series J.



Features: Designed for small, integral hp and fractional hp motors. Both hubs and sleeves are made of high-strength, stress-relieved nylon, tested to 1100 in-lb., with a recommended operating torque of 100 in-lb.

Specifications: Hubs bored for shaft sizes ⅜", ½", ⅝", and ¾",



TWO NEW RELIEF VALVES NOW AVAILABLE

GRESEN HYDRAULICS

1/3 *actual size*

SERIES PJ (Pilot Operated Valves) and SERIES J (High-lift Ball-and-Spring Type)

Both series feature unique design for minimum *crack* to *full flow* pressure differential and smooth, quiet operation. Both series, designed for *in-line* mounting, are available in ¾" and 1" pipe sizes and ¾", ⅞", and 1" tube sizes. Pressure adjustment range: 400-2500 psi for the PJ series, 400-2000 psi for the J series. Capacities up to 40 gpm (PJ series), 16-38 gpm (J series).

WRITE FOR LITERATURE

GRESEN *Mfg. Co.*

405 35th Ave., N.E., Minneapolis 18, Minn.

Circle **55** on Time-Saver Card

NEW!

RS-550

RANDOM REMOTE SELECTOR

Warco announces a homing type random selector ideal for solving remote selection problems.

When actuated, the RS-550 automatically steps to the proper contact, making the desired circuit and remaining there until actuated again. Rapid operation, about 100 steps per second at 115V A.C. Operates on a wide variety of AC and DC voltages. Handles a maximum of 12 selections per unit.

For full information, write for RS-550 literature today!

WARCO *Industries,* INC.

6625 DELMAR BLVD. • ST. LOUIS 30, MO.

Circle **136** on Time-Saver Card

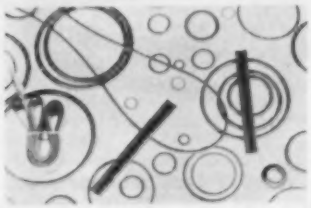
are fixed on shaft with two set screws. Two larger sizes have keyways also. Overall length of coupling, 2 9/32", 1 15/16" sleeve OD.

Waldron-Hartig Div.
Midland-Ross Corp.
New Brunswick, N. J.

Circle **317** on Time-Saver Card

FLUOROSILICONE RUBBER
. . . high modulus

Features: For seals, gaskets, cushion clamp material, flex coupling O-rings, diaphragms. Either molded or



extruded. Maintains physical properties from —65 to 450 F. Contains no plasticizers.

Specifications: Shore hardness 60 to 80.

Hadbar, Inc.
Rosemead, Calif.

Circle **318** on Time-Saver Card

BOOSTERS
. . . stroke 200 cpm

Features: Multiple-lip, self-energizing seals. Minimum friction. No complicated piping. No expensive

valves or controls. Can be moved from one machine to another. Maintains hydraulic pressure indefinitely, with no power consumption or heat generation. For petroleum-base oil and water-base fire-resistant fluids. Oil-to-oil boosters have same mounting dimensions. For single and double-pressure circuits. Available with integrally-mounted tank.

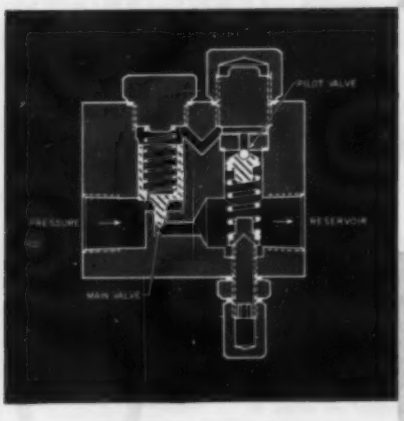
Specifications: Boosts 80-psi air to 3000-psi hydraulic.

S-P Mfg. Corp.
Cleveland, Ohio

Circle **319** on Time-Saver Card

Continued on next page

Constant Pressure regardless of flow variations



- Available with integral body as shown or as a cartridge type
- Standard Ports—¼", ⅜", ½" and ¾" pipe (NPTF)
- For oil

Pilot Operated Relief Valves

- Accurate pressure control assures efficient circuit
- Tight seal before cracking
- Can control pressure within 3% of setting

- Adj. Ranges up to 4,000 psi.

Write for detailed literature

Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

Fluid Controls, inc.

1284 N. CENTER STREET • MENTOR, OHIO

Member of National Fluid Power Association

Circle **43** on Time-Saver Card

Guided Stroke

INTERNAL KEY
TIE-RODLESS-TYPE SERIES 101A

Air 150 psi—Hydraulic up to 1500 psi
Fits where others won't
Meets JIC Standards, Bulletin 101A

WHEN a piston rod must hit right on the button to feed a work piece, activate an indexing table, push, pull, raise, lower, knock-out or clamp, you can count on an O-M Guided-Stroke Cylinder everytime. And there's no mystery about it, just top-level O-M precision workmanship, the latest and best machine tools, modern design, plus years upon years of engineering "know-how." And it's all spelled out with construction and performance details, engineering drawings as well as a capacity chart in each of our latest Bulletins.

Write for your copy TODAY. See why O-M Air and Hydraulic Cylinders maintain perfect rod alignment, make full-power starts, are designed right to seal right, have the lowest coefficient of friction and many other advancements.

Bulletin 101A for Internal Key Tie-Rodless-Type Air and Hydraulic Cylinders featured above.

Bulletin 105A—Improved Tie-Rod (Heavy Duty) Cylinders Hydraulic 2000 psi; 3000 psi non-shock.

Bulletin 107—Automation (Heavy Duty) Air Cylinder for 200 psi operation.

Bulletin 108—Automation (Heavy Duty) Hydraulic Cylinder—for 1000 psi operation.

All O-M Cylinders are available in ½" to 8" bores with standard, oversize, or heavy-duty rods. Complete line of mounts and interchangeable parts. Immediate delivery on most sizes. MAIL COUPON TODAY.

ORTMAN-MILLER MACHINE COMPANY
1143rd Street, Hammond, Indiana

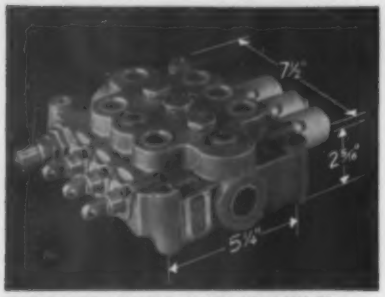
Send Bulletins
☐ Have representative call ☐ 101A ☐ 107 ☐ 105A ☐ 108

Name_____ Position_____
Company_____
Address_____
City_____ Zone____ State_____

Circle **100** on Time-Saver Card

Circle **66** on Time-Saver Card

Need up to 23 G.P.M. in Fluid Control?



COMPACT HUSCO 3300-SP MULTI-PLUNGER VALVE IS FOR YOU!

One of five basic sizes, HUSCO 3300-SP Valve offers unusual design and performance features that adapt it to wide application. Available to control up to *six* individual cylinders, single or double acting, permitting up to *four* positions of control for extreme versatility. Conventional or parallel circuit, check valve controlled. Compact, precision built for long, trouble-free service. Other HUSCO Multi-Plunger Valves in capacities from 3 to 185 G.P.M.

Write for detailed specifications on HUSCO 3300-SP and complete catalog "Husco's House of Ideas" — or engineering aid on your hydraulic control needs.

HUSCO

HYDRAULIC UNIT SPECIALTIES CO.

PUMPS • VALVES • CYLINDERS

P. O. Box 257-A, Waukesha, Wisconsin

West Coast Representatives

EASTMAN PACIFIC CO., Los Angeles, Calif.

ROY BOBBS AIR-DRAULIC CO., Portland, Ore.

NEW PRODUCTS

RETAINING RING
. . . is self-locking

Designation: Spirolox

Features: Two-turn, spiral-wound rings have two slots and two punched tangs. Rings lock when fast rotation increases centrifugal force, or when foreign matter tries to force ring from groove. Flat spring steel ring is coiled on edge for 360-deg retaining surface. No lugs, no protruding parts. Need no special tools. Can be coiled to any diameter within limits of material. Variety of materials and finishes. Balance suits rings to high speeds.

Ramsey Corp.
St. Louis, Mo.

Circle **320** on Time-Saver Card

FLEXIBLE METAL HOSE
. . . is as strong as a pipe

Designation: Guardflex

Features: Protective stainless steel covering is in two halves. Their extended flanges are welded over a seamless, helically-corrugated inner core. Vertical or horizontal arcs need no support. In straight-line installations, flanges prevent sagging or whipping. Control flexing in one direction. By coupling two lengths with flanges at different angles, flexing can be controlled in opposite directions on same installations. Practically abrasion-proof. Inner core of seamless bronze or stainless steel tube helically corrugated. Withstands high pressure. Can support plastic tubing and hydraulic hose.

Specifications: Hose ID from ¼" to 2". Bending diameter from 14" to 40".

Guardflex Metal Hose., Inc.
Garden City Park., L. I., N. Y.

Circle **321** on Time-Saver Card

"All the world's **Our** *stage"...*

Manufacturers all over the world have discovered the importance of fitting 'SUPERFECT' Oil Seals and Hydraulic Packings for perfect performance under the most exacting conditions.

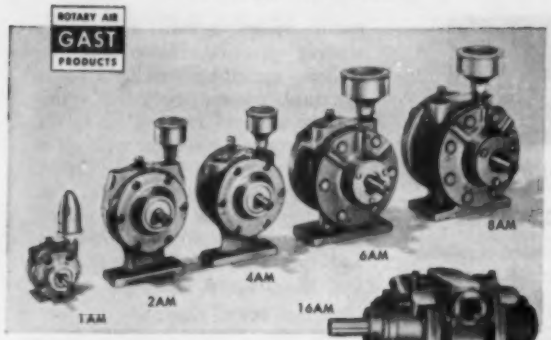
There is a type of Seal to meet virtually every need. Our Research Department is available to help solve any sealing problems.

A brand new catalogue is in the course of preparation. May we reserve one for you?

SUPERFECT

SUPER OIL SEALS & GASKETS LTD.
KINGS NORTON FACTORY CENTRE,
BIRMINGHAM 30 • ENGLAND

Circle **49** on Time-Saver Card



Six sizes . . . all variable speed, explosion-proof

GAST AIR MOTORS

Need compact, low cost power? For plant use and original equipment applications, Gast rotary-vane Air Motors offer these distinct advantages:

1. Explosion-proof power. No danger!
2. Low initial cost per rated h.p.
3. Variable speed with valve control.
4. Can't burn out from overloads.
5. Vanes take up their own wear.
6. Reversible rotation (opt.) 5 sizes.
7. Very compact — light in weight.
8. Top-quality ball-bearing design.

TYPICAL PERFORMANCE

Model No.	H.P. at 90 PSI 2000 RPM	Weight lbs.
1AM	0.13	1½
2AM	0.57	5½
4AM	1.1	8
6AM	2.0	17
8AM	4.0	25
16AM	7.0	65

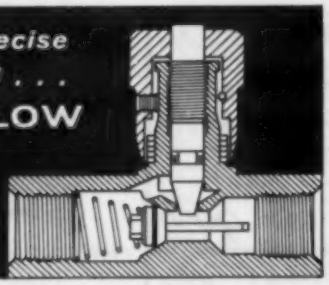
Gast Manufacturing Corp.
P.O. Box 117-D
Benton Harbor, Mich.

Write for Bulletins — specify models!

GAST ROTARY
"Air may be your answer!"

For more precise Flow Control . . .

COLORFLOW FLOW CONTROL VALVES



. . . with exclusive color and number calibrated adjustment

- For oil, gas, vacuum, water and other fluids
- Pressures: Brass to 2000 psi Steel to 5000 psi
- Sizes: ⅛, ¼, ⅜, ½ and ¾" dry seal pipe threads

- **Simple reading, recording, setting and adjusting**
- **Safe — adjustable under pressure**
- **Setting can be locked to hold adjustment**
- **Extremely sensitive — provides high flow and minimum pressure drop**

Write for detailed literature

THE MANATROL Corp.
2372 W. 7th St. • Cleveland 13, O. • CH 1-0575

Circle **84** on Time-Saver Card

MINIATURE SOLENOID VALVES

• Small Size: (1½"x2¾") • Large Capacity • Packless—only 2 moving parts

Available in 2- and 3-way normally open and closed types, this new line of solenoid valves has a pressure range from 0 to 400 psi. Bodies can be supplied in stainless steel, brass and aluminum.

NEW FEATURES:

- Operating temperature of +110° C to −65° C—higher temperature requirements can be supplied on special order.
- Many modifications are possible including side, bottom and top metering (3-way and 2-way normally open).
- Several models are U. L. Approved.
- New Type "S" valve designed for completely noiseless operation.

FOR MORE INFORMATION WRITE FOR BULLETIN V.

ALLIED CONTROL VALVE DIVISION
ALLIED CONTROL COMPANY, INC.
2 EAST END AVENUE, NEW YORK 21, N. Y.

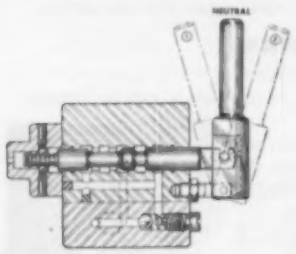
AL-127

Circle **7** on Time-Saver Card

new 10,000 psi FOUR-WAY VALVES

effortless operation for applications up to 10,000 psi

Have valving problems on hydraulic applications calling for high pressures up to 10,000 psi? This new GREENLEE Four-Way Valve may be your answer. Simple, trouble-free spool-type valve . . . completely balanced to provide effortless operation at any pressure in any position. It operates with the same ease at 10,000 psi as at 0 psi. Panel mounted for universal adaptability. Subplate available. Precision-made, precision-tested. (Max. leakage 4 cu. in. per minute at 10,000 psi.) Write today for illustrated data sheet.



GREENLEE Four-Way Valve is available in two models: No. 1717 (above) with detent-positioned control lever . . . No. 1704 with spring-centered control lever.

THE GREENLEE LINE ALSO INCLUDES A WIDE SELECTION OF HAND AND POWER-OPERATED HYDRAULIC PUMPS

GREENLEE

GREENLEE TOOL CO.

1776 Columbia Ave., Rockford, Illinois

Circle **53** on Time-Saver Card

USEFUL LITERATURE

Continued from page 62

PIPELINE AFTERCOOLERS

Steel shell. Corrosion-resistant tubes and tube-sheet. Removable tube bundle. Packed floating head. Nonmetallic baffles. Centrifugal moisture separator. For single and two-stage compression. Operating pressures to 125 psig. Temperature approaches of 10 and 15 F. Cools air and other gases. Type A-100. Bulletin B-5529 also describes other products. *American-Standard Industrial Div., Detroit, Mich.*

Circle **408** on Time-Saver Card

AIR & OIL DRILL FEEDS

Manually-controlled: pull on operating handle admits compressed air to cylinder, moves crosshead. Movement of attached operating chain rotates sprocket mounted on spindle pinion shaft. Spindle advances to work. Push on operating handle raises spindle quickly to starting position. Electrically-controlled: operating handle actuates electrical control switches, which operate solenoid-actuated air valves. This permits connection with other automatic apparatus. Hydraulic models work in the same way, but give more thrust. Catalog FM-60 has photos, descriptions, drawings, and specifications. *Beckett-Harcum Co., Wilmington, Ohio.*

Circle **409** on Time-Saver Card

UNIONS & VALVES

Engineering data, sizes, weights, and dimensions. Hot-forged steel pipe unions are convertible. To change standard-weight pipe union to orifice type, insert cup-orifice plate. Pressure ratings governed by 3-to-1 safety factor and strength of union, rather than orifice plate. Ductile iron check valves for 3000 psi air, oil, water, or gas. Remove working parts without taking valve from line. Opening pressures from 10 to 2000 psi. Turn web guide to adjust. Double union swing check valves for 1000 psi wog. Catalog 60. *Catawissa Valve & Fittings Co., Catawissa, Pa.*

Circle **410** on Time-Saver Card

palley/s SAVE UP TO 85%

SPECIAL VALUE
LARGE VOLUME STRATOPOWER PUMP

A high volume, positive displacement type hydraulic pump. Has an output to 10 gallons per minute at 1500 RPM with 3000 PSI. Maximum RPM is 4000. Has 16 tooth spline shaft. Part No. AND-20002. 99.50

NEW PALLEY Hydraulic Cylinders

These special Palley Hydraulic cylinders are designed to meet the most rigid requirements of industry. All are of heavy duty steel. Shown here are two of our line.

Available in heavy duty Press type cylinders of 3", 5", 6" and 8" bores, with thrusts up to 75 TONS. Also in internal cap types (as at right, above)—with bores up to 4" and up to 18,850 lbs. of thrust at 1500 PSI. Write for complete list of Special Palco Hydraulic Cylinders.

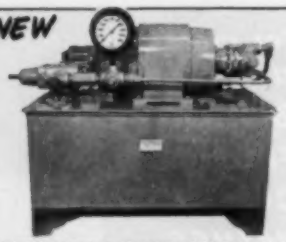
SURPLUS 1500 PSI HYDRAULIC CYLINDER
Has bore of 3" – shaft 1-3/16" – stroke 24" – O/A length 31". Reconditioned. 34.50

palley/s Cat. No. H-36RSU

2263 E. VERNON AVE., DEPT. AH-60
LOS ANGELES 58, CALIF.

TO ORDER: Send Check or M.O. – 1/2 deposit with C.O.D.s. Prices F.O.B. Los Angeles. All items shipped freight or postage collect.

NEW



HYDRAULIC "AUTOMATION" "HI-LO" PRESSURE PUMPING UNITS
DELIVERS 21 GPM AT 1500 PSI

For use in applications where a fast approach to work load is desired. Will deliver combined volume of both pumps (21 GPM), at pressures up to 450 PSI, then delivers output of high pressure pump (4 GPM) at up to 2000 PSI. Both pumps are face mounted on a 5HP, double end, 220/440, 3-phase, 60 cycle AC motor. Mounted on a 33 gal. reservoir (available without reservoir) Size: 35" long x 18½" wide x 18½" high. Only 625.00
Other Hi-Lo units available, write for details. Cat. No. DPR-21-1500.

2250 PSI CORNELIUS COMPRESSOR AND 115 V. MOTOR 99.50
SAVE! OUTPUT 0.6 CFM

Consists of a Surplus Cornelius Compressor – combined with a New 1/2 HP, 115/230 V., 60 cycle AC motor; a mounting frame and built-in carrying handle. Pressure tested up to 3000 PSI. Ideal to fill air tanks, laboratory use, etc.

Circle **101** on Time-Saver Card

AIR-OPERATED VALVES

Saunders type valves for throttling and on-off control. Air pressure on flexible diaphragm closes valve. Diaphragm seats against transverse weir in bottom of valve body. Flow is pinched off. Stud connection molded into diaphragm lifts diaphragm. Air to 60 psi closes against 150 psi. No stem packing or stuffing box. Moving parts completely enclosed. Cast iron diaphragm housing. Oversized stem bearing assures constant stem alignment despite high pressure differentials on valve diaphragm. Five types. Special features increase thrust output. Selection data and formulas. Bulletin HB-7. 8 pages. *Conoflow Corp., Philadelphia, Pa.*

Circle **411** on Time-Saver Card

GEARED FLEXIBLE COUPLINGS

Two externally-geared steel hubs engage with internally-geared steel sleeve. Two-piece metal cover protects these working parts. Synthetic rubber O-rings between sleeve and cover, and plastic-coated, felt hub-seals retain lubricant and keep

contamination out. Spiral-cam fasteners (part of covers) join cover halves. No flange bolts. Bores for push or press fit on ground shafting. Each hub has keyseat and setscrew. Lubricate in less than a minute. For shafts to 2½" diameter. Bulletin has photos, charts, drawings, dimensions. *Link-Belt Co., Chicago, Illinois.*

Circle **412** on Time-Saver Card

FLOW METERING

Full-View Rotameters for corrosive services. Laminated safety glass. One-piece stainless steel frame. External, hex-screw, packing gland bolts may be externally adjusted without special tools. Packing assembly moves straight down as bolts are tightened. If assembly is tightened unevenly, gland ring can't break metering tube. Gland ring exerts uniform pressure on packing, confining the most volatile fluids. 3 types. Variety of construction materials. Ar-Met Rotameters have electric or pneumatic, interchangeable, indicating and transmitting extensions. Specials available. Bulletin 150. *Brooks Rotameter Co., Hatfield, Pa.*

Circle **413** on Time-Saver Card

MULTIPLE SURFACE FILTERS

Capacity from 0.1 to 50,000 gph. For liquids and gases. Materials insure against contamination from corrosion. Large capacity, small volume. Easily accessible filter element. No pumps, pipes, or tanks for re-cycling. Accommodate any cake thickness. Jacketed construction for —365 F to 900 F. Working pressures to 10,000 psi. Elements withstand 10,000 psi differential pressure. Cleanable elements will stand abuse. Two types, eight models. Release M-208A has engineering data for porous stainless steel. Describes corrugated element. Drawings, charts. *Micro Metallic, Div. Pall Corp., Glen Cove, N. Y.*

Circle **414** on Time-Saver Card

Continued on next page

Fall . . . *the original*

SPRING-LOADED

Wiper **Ring**

This patented closed joint ring provides squeeze - grip action, assuring complete contact on the rod at all times. Maintains uniform, continuous pressure on wiper edge. Rods are always clean in any temperatures.

Fall "CJ" Wiper Rings operate most effectively under extreme conditions of dust, glaze, oil, grit, powder, gases, sand, ice, etc. Available in diameters ½" through 13". For any commercial use. Used by military and aviation industry since 1944.

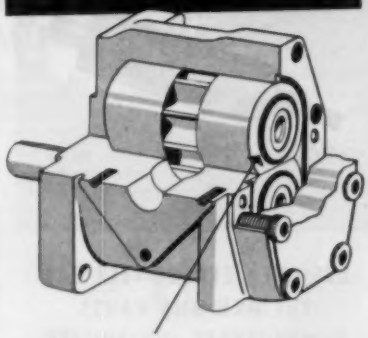
ACE PRODUCTS CO.

1820 N. 12th St. Toledo 1, Ohio
Est. 1935

Circle **1** on Time-Saver Card

HYDRAULIC Gear Pumps

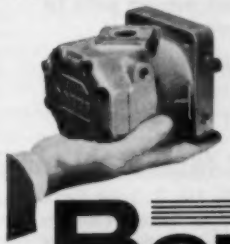
Pressure balanced for efficiency



The application of discharge pressure to the bearings as shown creates an optimum counter balancing thrust toward the gear faces which controls leakage and wear.

This feature permits operation with volumetric efficiencies in excess of 90%. Pump sizes from ½ to 60 GPM in 15 models with pressures to 2500 PSI. Also available as gear motors with outputs to 25 HP.

DOWTY
Hydraulic Gear Pumps



Truly a handful of efficient power offered by

Berry
HYDRAULICS
A DIVISION OF THE OLIVER TYRONE CORPORATION

MAIL FOR APPLICATION DATA

Berry Hydraulics
2230 Oliver Building, Pittsburgh 22, Pa.

Name_____

Company_____

Address_____

Circle **25** on Time-Saver Card

DESIGNED EXCLUSIVELY FOR THE MAN WHO WANTS COMPACTNESS, RELIABILITY AND ECONOMY!

Introduced by Modernair in 1948, these ultra-compact cylinders have been performance-proved on thousands of jobs all over the free world.

Today's new Series R ECONOMAIR cylinder is even better. In addition to such original advantages as compactness and interchangeable mountings, the new Series R offers:

- **Chrome plated stress-proof steel piston rods with wrench flats.**
- **Built-in rod wipers.**
- **Wider-sectioned aluminum piston for improved bearing stability.**
- **Exclusive Adjusto-Stroke Design. (Pat. Pend.)**
- **1⅛ bore has stainless steel rod.**

Series R ECONOMAIR cylinders are available now in 1⅛, 1½, 2, 3 and 4-inch bore sizes, with or without cushions. They offer today's best buy in quality cylinders at truly competitive prices—why pay more and get less?

See your phone book yellow pages for your nearest dealer or write us **now** for literature and prices. Please address Dept. 05.

Modernair CORPORATION

400 Preda Street • San Leandro, California
5007 Brookpark Road • Cleveland 34, Ohio

Circle **94** on Time-Saver Card

USEFUL LITERATURE

SILICONE PRODUCTS

Engineering Guide describes uses and properties of silicones. Products include defoamers, pneumatic grease, valve lubricant, and thread protectant. Charts. Photos. 16 pages. *Dow Corning Corp., Midland, Mich.*

Circle **415** on Time-Saver Card

BEARINGS, BUSHINGS, BAR STOCK

Twelve-page brochure has six pages on specifications, chemical composition, and mechanical properties of brass and bronze casting alloys, and manganese and aluminum bronze alloys. Description of Promet alloys. Formulas for running clearances. Characteristics of effective lubrication. Pictures of types of oil grooving. Illustrations of laboratory, engineering, pattern shop, foundry, and machine shop facilities. *American Crucible Products Co., Lorain, Ohio.*

Circle **416** on Time-Saver Card

HIGH PRESSURE VALVES & FITTINGS

For 30,000 and 60,000 psi. 2-way, straight or angle valves. 3-way valves have one or two connections on pressure side. 3-way, 2-stem combination valve. Connections for ⅛", ¼", ⅜", 9/16" tubing. Couplings, reducer couplings, reducer adapters. Elbows tees, crosses. Gage connectors — coupling, direct-contact, straight, tee, and cross types. Check valves, excess surge and check valves. Ball check, straight or angle. Line filter, safety head assemblies. Plugs, nipples. Relief valve controllable to 5% maximum pressure differential. Catalog 659 has drawings, dimensions, and parts numbers. *High Pressure Equipment Co., Inc., Erie, Pa.*

Circle **417** on Time-Saver Card

4-WAY VALVES

Subplate, flanged, and pipe tapped. Manually operated. Dirt-tight. Weather-tight. Sizes ¼" to 2". Twelve data sheets have operation diagrams, parts drawings, and mounting diagrams for each valve. Charts of all spools. *Double A Products Co., Manchester, Mich.*

Circle **418** on Time-Saver Card

Is clean, dry, oil free air

designed into your

Compressed air system?

Only with Adams Aftercoolers and Cyclone Separators can you get virtually **complete** removal of pipeline oil and water vapor — for these reasons:

1. MORE COMPLETE CONDENSATION. Adams Aftercoolers reduce air or gas temperature to within 10° of cooling water. With their efficient counter-flow design, the air passing through the tubes is cooled by 13-pass cooling water over the tube bundle. This cooling achieves maximum condensation of oil and water vapor.

2. MORE COMPLETE SEPARATION OF OIL LADEN CONDENSATE. Adams Cyclone Separators have a unique conical design which produces efficient, 2-stage separation; first, heavier particles in the upper portion; then the finest particles are removed in the inner vortex formed within the conical area. This offers a constant high separation factor over a wide range of volumes—a characteristic not possible with baffle and other type separators.

You pay no more for superior Adams performance because of Adams specialization in these units for over 25 years. They have engineered the extra features into mass-production techniques which keep unit costs down.

New Bulletin 714 merits your attention for fullest possible protection to your air-actuated equipment. Write for your copy today.

R. P. ADAMS CO., INC. • 249 East Park Drive, Buffalo 17, N. Y.

Circle **2** on Time-Saver Card

Circle **29** on Time-Saver Card

STAFFA

HIGH TORQUE VARIABLE SPEED (1-100 r.p.m.) HYDRAULIC MOTORS

Mark IV—5 cylinder 4,500 lbs. ft. at 2,000 p.s.i. (Speed 1-100 R.P.M.) **Mark V**—7 cylinder 6,600 lbs. ft. at 2,000 p.s.i. (Speed 1-75 R.P.M.) Overall efficiency 90% to 95%.
Ideal drive for conveyors, rolling mills, cranes, tractors, drills and most mechanical handling applications.

Ask for details of hydraulic cylinders, valves, pumps and motors.

CHAMBERLAIN INDUSTRIES LTD

Staffa Works, Argall Ave., Leyton, London, E.10, England.
Leytonstone 3678

(Member of the Chamberlain Group of Companies)

KUNKLE GAUGES

FOR PROCESS & POWER INSTRUMENTATION

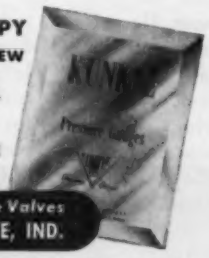
KUNKLE GAUGES

Complete, broad range line makes gauge application-specification easy with assured results backed by 50 years of gauge manufacturing experience.

Ranges from 15 p.s.i., or 30" of vacuum, to 20,000 p.s.i.

Bourdon tubes of bronze, drawn or bored s/s, and other alloys

YOUR COPY SHOWING NEW GAUGES AND SPEC. DATA NOW AVAILABLE WRITE:



By the makers of dependable Kunkle Valves
KUNKLE VALVE CO. · FT. WAYNE, IND.

Circle **76** on Time-Saver Card

HOKE Flow Sheet

HOKE REPORTS ON FLUID CONTROL (2)

WE PACKED PERFORMANCE IN A PACKLESS VALVE

The development of packless valves has so greatly reduced the problems of handling high pressures, temperatures and vacuums, and dangerous fluids that engineers designing such systems can now spend more time curled up with the Hoke Corrosion Chart.*

With this extra time, many have dreamed up weird applications for the Hoke 440 Series bellows seal valve, trying to snare us in our own semantics. In a rash moment, we boasted that this valve could be modified for almost any application. Actually, the 440 can be modified to work at high pressures (up to 2000 psi), for high temperatures (up to 1000°F.), and for special connections such as tubing, socket welding, and silver brazing.

The cesium boiler shown above uses a modified version of the Hoke 440 series bellows seal valve.

Aside from this horn-blowing, here are the dry facts. The basic design includes a stainless steel body, inert arc-welded bellows assembly, Teflon gaskets and Teflon stem point discs. This is only the starting point. Minor modifications make so many models available that almost any problem, including liquid metal handling, can be solved.

Hear what a disbeliever said: "I did not believe that the modified valves would satisfy all my requirements, especially to keep a high vacuum of the order of 10^{-5} mmHg under a wide variation of temperatures; however, I now acknowledge that the modified Hoke 440 valves fulfilled their duty perfectly." This came from The Martin Company, where we sent 440's for use in cesium vapor up to 400°F. Special modifications made these valves readily usable on a cesium boiler and converted an infidel to the true valve.

If you work with critical high vacuum, high pressures, high temperatures and dangerous fluids, proceed with care. Ask for our Packless Valve Bulletin to reap a harvest of engineering plums.

**Makes good reading if you're handling corrosive agents. Write, and we'll send you one.*

FREE! A STEADY FLOW OF FACTS!

Further flow features, and interesting technical topics are carefully covered in Hoke's technical publication, the FLOW SHEET. It's free, but worth millions!

Hoke's Performance Guarantee — Every Valve Leak-Tested!

HOKE INCORPORATED
87 Piermont Road, Cresskill, N. J.

Send me complete information on the Hoke products checked below:

☐ Packless Valves ☐ FREE Corrosion Slide Rule
☐ Flow Sheet ☐ Complete Catalog GC 959

NAME_____ TITLE_____

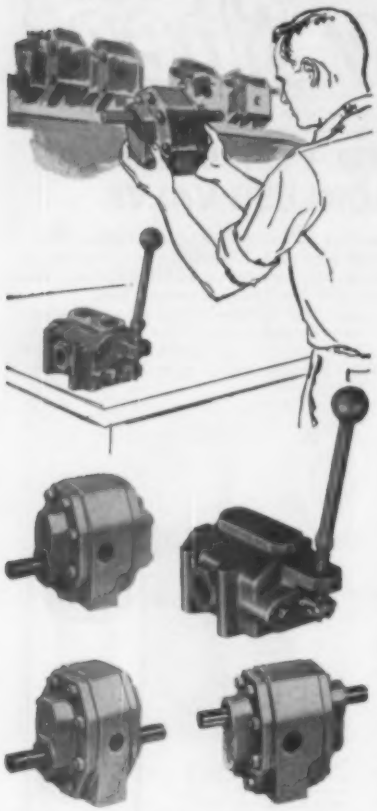
COMPANY_____

ADDRESS_____

CITY_____ STATE_____

Circle **61** on Time-Saver Card

"Off the Shelf"
HYDRAULIC
EQUIPMENT



in capacities from
8 to 25 gallons...
up to 1000-1500 psi

Engineered by the world's largest manufacturer of hydraulic jacks, Hein-Werner pumps, motors and valves offer compact, high precision, light weight, balanced design. *Valves offer*: large oil passages, close grained high tensile body castings, spring centered ball detent hold, pressure relief valve and hardened seat INSERT for long life. *Motors and Pumps* feature forced lubrication and internal bleeding for axial balance and to eliminate high pressures against oil seals; rotation in either direction, heavy duty roller bearings and gear type constant displacement.

FOX RIVER MFG. CO.
A DIVISION OF
Hein-Werner CORPORATION
OSHKOSH 4, WISCONSIN 5014
Circle 44 on Time-Saver Card

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

American-Standard appoints Koch

Promotion of John B. Koch to director of engineering for the Kewanee (Illinois) plant has been announced by American-Standard Industrial Division, Detroit, Mich. Koch joined the company in 1936, and prior to assuming this new post was assistant director of mechanical design.

Koch

Kohl

Periflex elects Kohl president

Formerly secretary and general manager of Periflex, Inc., Hazel Park, Mich., John Kohl was elected president. Roger R. Schumacher, former Chicago district sales manager, was elected vice president and general sales manager and Mrs. Clara Gravel secretary.

Rucker makes changes

The Rucker Co., Oakland, Calif., has given D. J. Bentley the new position of plant manager. He was with Consolidated Western Steel, Maywood, Calif. Howard C. Zintz, formerly chief engineer, is now director of engineering. Albert B. Roth, who was assistant chief engineer, replaces Zintz. Duane Shaw has moved up from senior project engineer to replace Roth. Walter H. Hubrig, project engineer, is section head, mechanical design. Robert G. Hurlbut, who was senior accountant, is office manager at Oakland. Richard E. Deter, inside salesman with the Los Angeles office, now manages the office.

Bill Whitney joins W. S. Shamban & Co.

Bill Whitney is now eastern sales engineer for the plastics line of W. S. Shamban Co., Culver City, Calif. He travels New York City, New Jersey, eastern Pennsylvania, Delaware, Maryland, and part of Virginia. He was technical representative of Spencer Chemical Co.

Fluid Controls names two executives

Fluid Controls, Inc., Mentor, Ohio, appointed Robert L. Merian vice president for marketing and Ernest A. DiBartolo to head product development. Merian, who

Merian

DiBartolo

served as sales and general manager of Industrial Distributors, Inc., before joining Fluid Controls, will have full responsibility for marketing the company's complete line of hydraulic products. DiBartolo will be responsible for the development of new products and improvement of existing lines.

Continued on page 142

Circle **5** on Time-Saver Card

new ROTORAM® VALVES

WITH EXCLUSIVE ROTATING STEM

for MILLIONS of TROUBLE-FREE ACTUATIONS

Treadle Valve

Knob Valve

- Low silhouette mounting
- 2024 T4 aluminum bar stock
- Rust-resistant
- Full flow air passages
- Piped exhaust ports
- Interchangeable parts
- Anodized finish

Cam Valve

Finger Valve

Pedal Valve

Hand Ball Valve

Rotoram Valves are available in 3 and 4-way models for ⅛", ¼", ⅜" and ½" pipe sizes. Special Block "V" Packing permits free ram movement, insures long valve life. Port entry from either left or right side. Ask your AIR-MITE Distributor, or write for complete details and illustrated catalog.

AIR-MITE DEVICES, INC.

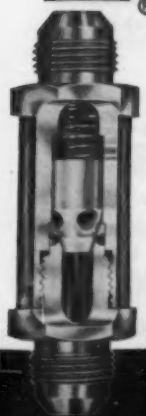
4401 W. Kinzie St., Chicago 24, Ill.

Kep-O-seal

Kep-O-seal

Kep-O-seal

Kep-O-seal®



Flexible Seal Seat* VALVES

- CHECK VALVES
- RELIEF VALVES
- SHUTTLE VALVES
- CARTRIDGE VALVE INSERTS

Specify Kep-O-seal! — leakproof construction designed for efficient fluid flow and reasonable cost. This name is your assurance of quality; backed by two generations of specialized service to industry.

*PAT. APP'D. FOR.

Write for Complete Detailed Information.

KEPNER PRODUCTS COMPANY

7321 West 59th Street Summit, Illinois

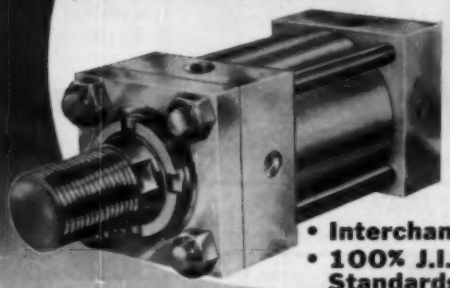
Circle **75** on Time-Saver Card

For Smooth, Precise, Sure Power

SP

HIGH-PRESSURE HYDRAULIC CYLINDERS

2000 PSI (3000 PSI non-shock)



- **Interchangeable**
- **100% J.I.C. Standards**

12 Bore Sizes: Compact 1⅛" thru 12"

Quick-Change Front Removal Cartridge

Self-contained unit externally removable, no need to loosen tie rods or dismantle the cylinder.

Interchangeable Cushion Check and Adjustment

For maximum flexibility; space-saving flush design; easy to adjust.

"Clinch-Tite" End Seal

Maintains leakproof seal at all pressures, ends "O" ring extrusion at pilot fit.

Heli-Coil® Piston Lock

Easy rod service with no loss of thread strength; meets rigid aircraft standards.

A-767A

MORE POWER from line air with S-P BOOSTERS

For *intensified* hydraulic pressure that you can control for punching, riveting, clamping, pressing, shearing, crimping—add an S-P Air-Oil Booster to your air line—no maintenance, no pumps, no valves; saves space, uses line air to hold intensified pressure as long as desired. Write for Catalog 116.

PROVEN QUALITY SP CYLINDERS · CHUCKS SPEED · PERFORMANCE

FREE Engineering Service
Representatives in principal cities
Phone or Write Today

Find us fast in the 'Yellow Pages'

THE S-P MANUFACTURING CORP.

30201 Aurora Rd. • Cleveland 39, Ohio

A BASSETT COMPANY • IN GREATER CLEVELAND • ESTABLISHED 1918

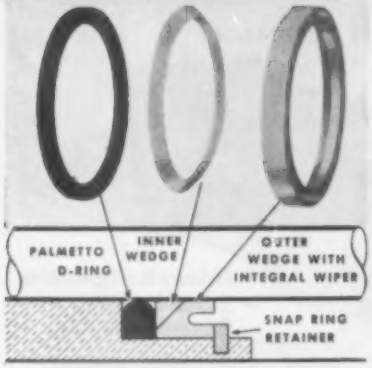
Non-Rotating and Rotating AIR and HYDRAULIC CYLINDERS • VALVES
POWER CHUCKS • COLLET and DRILL PRESS CHUCKS • ACCESSORIES

Circle **121** on Time-Saver Card

Designing With the D SEAL W

PATENTS ISSUED AND APPLIED FOR

—the newest advance in packing technology from PALMETTO® Engineering



• The new Palmetto D-W Seal provides a compact, low-cost seal which matches the performance of costlier, bulkier packings. Designed primarily to provide a superior seal on rods subject to reciprocating motion in hydraulic or pneumatic service.

The unique D-W Seal offers these outstanding advantages: SHARPLY REDUCED MACHINING COSTS • LESS COST FOR PACKING • SAVING OF SPACE • POSITIVE SEAL WITHOUT EXTRUSION • INTEGRAL ROD WIPER

HOW THE PALMETTO D-W SEALS

Palmetto D-ring, installed under slight compression, rests firmly on its square base . . . provides a positive seal under low or high pressure. Double wedge back-up rings contribute bulk and stability . . . guard the D-ring from rolling, twisting, or extruding. Self-centering action of seal assembly also adds bearing support . . . helps center the rod while under pressure. Lip on second wedge exerts dependable wiping action . . . avoids need for separate wiper element. Entire D-W seal assembly fits into counter-bore in cylinder head . . . is secured with a snap ring near cylinder head's outside surface.

Since the D-ring element is furnished in a broad range of rubber compounds, the D-W Seal operates with any fluid and at temperatures from minus 70F to 600F. The standard back-up wedge rings are made of nylon, but other plastics or metals can be supplied to meet specialized application conditions to give the D-W Seal complete versatility.

• *For more particulars, write:*

GREENE, TWEED & CO.

NORTH WALES, PA

Circle **52** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

LeBurton Webster made controller of Jamesbury

Jamesbury Corp., Worchester, Mass., has appointed LeBurton D. Webster as controller. He was assistant corporate controller of Raytheon Co.

Webster

Topinka

Topinka takes Hannifin post

George F. Topinka has been made chief engineer, Power Cylinder Div., Hannifin Co. Div., Parker-Hannifin Corp., Des Plaines, Ill. Topinka joined Hannifin from Borg & Beck Div., Borg-Warner Corp. He was administrative engineer in charge of new product design and development.

Walton and Monahan join Houghton staff

E. F. Houghton & Co., Philadelphia, Pa., has employed Warren J. Walton as lubrication engineer. Neil F. Monahan has been made assistant to the manager of the Hydraulics & Transmission Dept.

Baldwin forms hydraulic servo division

Baldwin Industrial Controls Div., Baldwin Instrument Co. Ltd. has formed a hydraulic servo division. J. C. Wells, with Baldwin since August, heads the division. He was chief hydraulic engineer of Solatron Industrial Controls Ltd.

Winston takes sales post with Tri-Point Plastics

Tri-Point Plastics, Inc., Albertson, N. Y., has added Ben Winston to its Eastern Division Teflon sales force. Primary responsibility will be the New York-Long Island area. He was Metropolitan New York sales manager for the company's electronics division.

Fuller assigns Johnson to foreign sales post

Robert M. Johnson has been named assistant manager of the Foreign Sales Div., Fuller Co., Catasauqua, Pa. He became a Fuller administrative assistant in 1949.

Scott Industrial appoints Stewart

Harry L. Stewart has been appointed manager of Scott Industrial Equipment Co., Indianapolis, Indiana. He was with Logansport Machine Co. since 1942. Stewart was on the NFPA Educational Committee, and the Hydraulics Standards Committee of the National Machine Tool Builders Association. He is the author of one fluid power book, and the co-author of another. His articles have been in many technical magazines.

Stewart

Siebel

Siebel joins Pall Corporation

Dr. Mathias P. L. Siebel is now general manager of the new Pressure Equipment Div., Pall Corp., Glen Cove, N. Y. The division will design and manufacture pressure, differential pressure, and flow measuring and controlling devices. Educated in England, Dr. Siebel came to this country in 1957. He was a research associate at Columbia University, and a machine design consultant.

Le Roi changes sales approach, names seven

Le Roi Division, Westinghouse Air Brake Co., Milwaukee, Wis., will sell by markets, rather than by product lines. D. S. Permar, as manager, general industrial

Permar

Koehler

Gavigan

Dondero

sales, will head sales of large stationary compressors and smaller, unit-type compressors to the general industrial market, including original equipment manufacturers. He continues as assistant general sales manager. Le Roi promoted R. H. Koehler from general sales manager to vice president, sales. J. R. Gavigan was elevated from manager of administration and accounting to vice president, planning and administration. L. E. Dondero advanced from manager of the West Allis, Wis., plant to vice president, manufacturing. Frank Kuether, former head of engineering at West Allis, is now manager of engineering. Al Feucht, former manager of the Cleveland, Ohio, plant, is manager of manufacturing. John Miller, who was head of Cleveland accounting, is now manager of accounting.

Versa now in Englewood, N. J.

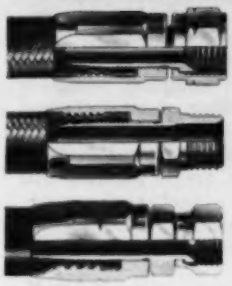
Versa Products Co. has moved from Brooklyn, N. Y., to 150 Coolidge Ave., Englewood, N. J. The new building offers more space for machinery and offices. It provides for an R&D department.

Continued on next page

Circle 80 on Time-Saver Card

Specify LENZ INDUSTRIAL HOSE FITTINGS

RE-USABLE
INTERCHANGEABLE
COMPACT



A Complete Line
- ASSEMBLIES
- ADAPTERS
- COUPLINGS
- CONNECTIONS
- 1 & 2 WIRE BRAID RUBBER HOSE
- RAYON HOSE
- ACCESSORIES

For 1 and 2 Wire Braid • 1 and 2 Rayon Braid

For your most demanding specifications... Lenz fittings meet J.I.C. and S.A.E. standards for low, medium and high pressure systems... Oil, Fuel, Water, Gas and others.

Write Today For FREE Hose Catalogs of Complete Line Specify Type

The LENZ Company
3307 Kiepinger Road
Dayton • Ohio
Phone: CR 7-9364

For Nearest Distributor See Thomas Register A-Z Section

See Fluid Power Directory for Complete Catalog

Pressures up to 1,500 p.s.i. with running speeds from 20 to 1,500 r.p.m. are possible with

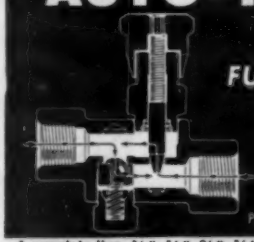
Savery
HYDRAULIC PUMPS

THOMAS SAVERY PUMPS LIMITED
BRACEBRIDGE ST., BIRMINGHAM 6, ENGLAND

American and Canadian Agents:—
DAVIES BROTHERS, Gladstone, New Jersey, U.S.A. PEapack 8-1290

Circle 122 on Time-Saver Card

AUTO-PONENT®
HYDRAULIC
FULL FLOW VALVES
Flow Control, Needle, Check, for HYDRAULIC Power



Model KF Flow Control Valve with Dial and Knob adjustment for direct reading and duplicating reference. Now available in Aluminum for 3000 psi

Pat. #2,841,174

A complete line: 1/8", 1/4", 3/8", 1/2", and 3/4" female Dryseal Pipe Sizes in all models and types. Equivalent Aeronautical Tube Sizes on special order.

MINIMUM PRESSURE DROP AND POWER LOSS . . . Oversize ports and passages give maximum flow at minimum pressure drop, insure greater accuracy and response in hydraulic or large volume air cylinder control.

EASY FLOW ADJUSTMENTS under full pressure. Seal located at port to eliminate air or dirt traps. Gland structure equally effective on pressure or vacuum.

SENSITIVE, CHATTERLESS BALL CHECK . . . Patented design insures rapid ball movement to open or close at low differentials.

FORGED BODIES permit higher pressures with wide safety margins. Aluminum—3000 psi; Steel and Stainless Steel—5,000 psi. Pressure ratings based on better than 5 to 1 safety factor. All internal parts are Stainless. Write for illustrated catalog.

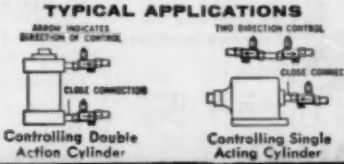
Model F Standard Flow Control Valve or Model N Needle Valve

Model KF Knob and Dial Flow Control Valve or Model KN Needle Valve.

Model FF Knob and Dial Flow Control Valve or Model FN Needle Valve for panel mounting.

Model C Check Valve for In-Line Mounting.

TYPICAL APPLICATIONS



Controlling Double Action Cylinder

Controlling Single Acting Cylinder

AUTOMATION AUTO-PONENTS INC. COMPONENTS
2919 GRANT STREET
BELLWOOD (Chicago Suburb) ILLINOIS

Circle 14 on Time-Saver Card

LET'S TALK MANIFOLD FACTS!

The advantages of (Almo) manifolds as opposed to other manifolds are many. Their unique design offers complete flexibility in the mounting of take-offs and valves. Thus an Almo manifold is more adaptable to your requirements. Here are 3 features that definitely effect performance, weight and size.

ALMO* HYDRAULIC MANIFOLDS

1. Flow lines are short as possible with no corners or sharp recesses to collect dirt and obstruct flow.

2. Method of construction permits better utilization of area, smaller overall dimensions and fewer complications while maintaining correct channel dimensions and constant operating pressures. PSI capacity is a built-in quality.

3. Rectangular cross section of flow lines makes possible thinner overall construction and less weight than in comparable manifolds.

WEIGH THESE FACTS!

Let us work with you in improving your product. Write for brochure.

ENGINEERING RECOMMENDATIONS

"THE UNIQUE FLUID CIRCUIT"

ALMO
MANIFOLD & TOOL CO.
11472 KALTZ / CENTERLINE, MICH.

Circle **8** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

New distributors

C. E. Conover & Co., Inc., Hasbrouck Heights, N. J., has become a distribtuor for Parker Seal Co. The Conover firm covers New Jersey, New York, Rhode Island, southern Connecticut and eastern Pennsylvania.

Crown products, made by Parker-Hannifin Corp.'s Hannifin Company Division, will be distributed by: *Hydra-Tec Corp.*, Great Neck, N. Y. *Honolulu Iron Works Co.*, Honolulu, Hawaii. *Tennessee Machinery Company*, Nashville. *Haskel Engineering & Supply Company*, Glendale, Calif. *Stambaugh Supply Company*, Youngstown, Ohio. *Powered Equipment Inc.*, Terre Haute, Ind. Parker hose fitting line will be handled by *Fluid Power Division of Equipment Sales Co., Inc.*, Atlanta, Ga. *Livingston & Haven, Inc.*, Charleston, South Carolina and Charlotte, North Carolina, will have the franchise for industrial tube and hose fittings. The company's Charlotte branch will also handle Crown products.

K. C. Brown Co., Kansas City, Mo., will cover Kansas and western Missouri for Hoke, Inc., Creskill, N. J.

McCracken and Company, Cleveland, was named distributor for Perfex Corporation's shell and tube heat exchangers.

The complete line of Moog Servocontrols, Inc., industrial products will be distributed by: *The Rucker Company* of Oakland, Seattle, Portland and Los Angeles for the states of Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon and Washington. *The J. N. Fauver Co., Inc.*, Detroit, for Michigan, northern Indiana and western counties of Ohio. *Lax Industrial Products, Inc.*, Cleveland, for the central and eastern areas of Ohio.

The Mastergauge GROUP

and companion "Master-test" group for extreme services requiring the ultimate in accuracy and stamina.

Right Quality GROUP

also for tough services, but less severe than the conditions served by the "Mastergauge"

Gauge Standard GROUP

for the general run of gauge services. Marsh quality and accuracy at a moderate price.

for every need

Within these three comprehensive Marsh groups you have the world's widest (yes, and wisest) selection of pressure gauges. These groups of gauges are not *grades* ...they are *kinds*...the MARSH kind... which means that each gauge, within the scope of its rated use, is the BEST of its kind!

Pick the right Marsh Gauge and you have the best answer to your gauge problem.

Ask for latest data

MARSH INSTRUMENT COMPANY

Division of Colorado Oil & Gas Corporation, Dept. 19, Skokie, Ill. Marsh Instrument & Valve Co., (Canada) Ltd., 8407 103rd St., Edmonton, Alberta, Canada. Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas.

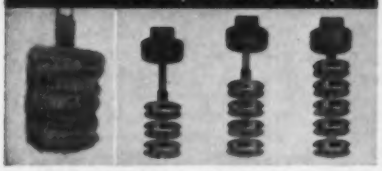
MARSH

GAUGES • THERMOMETERS
VALVES

Circle **86** on Time-Saver Card

Circle **73** on Time-Saver Card

NEW MAGNETIC CLEANER for HYDRAULIC POWER UNITS the Kebby Tank-Trapper



★ Powerful Alnico V Magnets
★ Highest Active Area
★ Engineered for Power Concentration
★ Easy to Apply
★ Low Priced . . . Quick Delivery
★ No Moving Parts . . . No Maintenance

MEETS NEW J.I.C. HYDRAULIC STANDARDS

The Kebby Tank-Trapper is specifically designed to complete the protection of hydraulic systems against damage by iron particles worn off moving parts of various components. It picks up material missed by the filter and prevents premature filter loading. Expensive shut downs and service calls are drastically reduced. Write for Bulletin 1-500-59.

THE KEBBY COMPANY
2320 Custer Avenue Rockford, Illinois
Designers and Manufacturers of Magnetic Devices, Kebby Mite and Filtrar Coolant Cleaners

MARKET PLACE

When replying to a box number in the Market Place, address your letter to Hydraulics & Pneumatics, 812 Huron Road, Cleveland 15, Ohio. Attention: Box No.

REPRESENTATION WANTED

Prominent manufacturer of air and hydraulic cylinders has several territories available. Please advise experience, lines handled, territory, mode of operation and any other pertinent data. Box 6160, HYDRAULICS & PNEUMATICS.

NEED SALES HELP?

Manufacturer of component parts for hydraulic and pneumatic cylinders, with national sales organization, oriented to O.E.M., is seeking contact with a manufacturer of an allied product which needs marketing. Write, outlining full particulars to Box 6260, HYDRAULICS & PNEUMATICS.

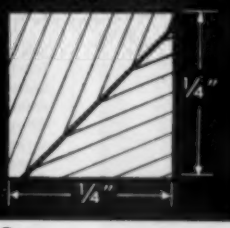
Classified Advertising Rates: Cost of Position Wanted ad is $10.00 for the first inch, each additional line 90 cents. Cost of all other classified ads is $20.00 for the first inch and $15.00 for each additional inch or fraction thereof. Rates for Display Ads in this section will be sent on request.

SENIOR PROJECT ENGINEER
or
ASSISTANT CHIEF ENGINEER
experienced in mobile equipment
HYDRAULIC

Long established mid-western manufacturing company with product diversification plans and excellent growth potential seeks graduate engineer with 6-20 years experience in the design and development of hydraulic products and systems. Resumes will be reviewed confidentially. Write to Box 6360, HYDRAULICS & PNEUMATICS.

PISTON LEAKAGE PROBLEMS ? ? ? CHANGE TO "STEP SEAL RINGS"

CROSS SECTION OF "STEP SEAL" JOINT



See the newest revolution in sealing rings by AUTO-DIESEL PISTON RING CO. The "STEP SEAL RING" has a sealing action over the entire area. This results in a ring that allows only ⅛ the leakage under 15 times the pressure of a straight cut ring—see comparison table below.

COMPARISON TABLE

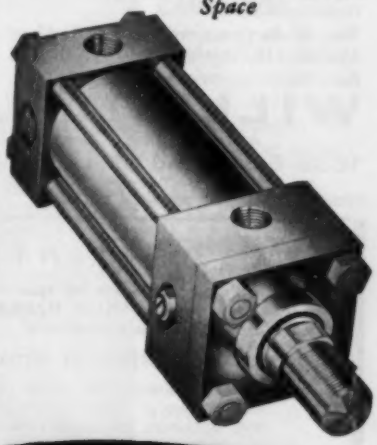
STRAIGHT CUT COMPRESSION RING	"STEP SEAL RING"
With .005" end clearance has leakage rate of 150cc/min. at 400 lbs. pressure.	With .010"-.020" and .030" has a leakage rate of only 25cc/min. at 6000 lbs. pressure.

To reduce leakage to a minimum specify "STEP SEAL RING"

For complete details write for Bulletin H-57

THE AUTO-DIESEL PISTON RING CO.
3141 Superior Avenue • Cleveland 14, Ohio

Maximum Working Force in Minimum Working Space



Milwaukee
Air or Hydraulic
CYLINDERS

• Quality Construction Throughout
• No Costly Down Time
• Guaranteed Top Performance
• Precision Designed—Heavy Duty Service
• Conforms to JIC Specifications

Get all the facts and see how Milwaukee Cylinders save space and weight . . . Save on original cost and save on maintenance.

Write today for Free Bulletins A-100 and H-100.

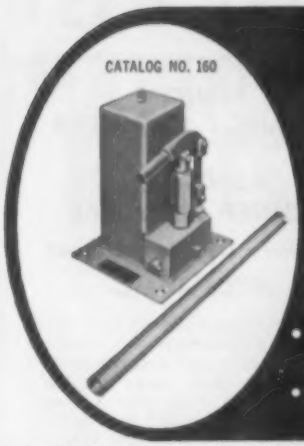
Standard Models
Hydraulic Bore Size 1½ to 12"
Air Bore Size 1½ to 14"
Specials built to your specifications

MILWAUKEE CYLINDER CO.
Division of L. & M. Machine Company

Circle **13** on Time-Saver Card

Circle **92** on Time-Saver Card

Circle **107** on Time-Saver Card



Hand Hydraulic Pumps

- Single and Double Designs to 20,000 psi
- With or Without Reservoir

160 cubic inch reservoir with 8"x 8" base plate and 18" long handle.

Available with optional size pistons ⅜", ½", ¾", 1" and 1½".

We specialize in the manufacture of hand pump units which operate in temperatures from −65° F. to +160° F. and with any capacity reservoirs required. Pumps can be furnished on special order with custom seals to handle various aircraft types of fuels such as Pydraul, Skydrol, Oronite, etc.

The single pump with ½", ¾", 1" or 1½" piston is now available in stainless steel.

for additional information write:

WILLIAM S. PINE

hydraulic hand pumps for 1001 uses

1635 East 22nd St., Los Angeles 11, Calif.

REPRINTS

The following reprints of special reports which have appeared in APPLIED HYDRAULICS & PNEUMATICS Magazine are available:

TEMPERATURE CONTROL IN HYDRAULIC SYSTEMS

A complete report on latest developments. Sixteen pages of data on heat generation, fluids and packings, heat dissipation, system design, oil coolers, immersion heaters, and automatic temperature control.

COMPONENTS FOR WATER HYDRAULICS

A special 16-page report covering the design, selection and sizing of pumps, valves, accumulators, packings and cylinders. The report covers also additives and air controls.

WHAT TO LOOK FOR IN AIR VALVES

This 16-page report contains basic designs of directional control, pressure control and flow control valves. Illustrates many different designs and points to remember in selecting a specific design.

Single copies 50¢; over 50 copies, 35¢ ea.

REVISED JIC HYDRAULIC STANDARDS

Single copy	**75c**
10 to 24 copies	**60c**
25 to 49 copies	**50c**
50 or more copies	**40c**

Send all orders—enclosing the exact amount in coins or checks—to: APPLIED HYDRAULICS & PNEUMATICS, 812 Huron Road, Cleveland 15, Ohio.

advertisers' index

JUNE 1960

Ace Products Co. 137
R. P. Adams Co., Inc. 138
Adel Precision Products Division
General Metals Corp. 45
Airmatic Valve, Inc. 124
Air-Mite Devices, Inc. 141
Alemite Division
Stewart-Warner Corp. 48, 49
Allied Control Valve Division
Allied Control Co., Inc. 135
Almo Manifold & Tool Co. 144
Ancher Coupling Co., Inc. 7
Anker-Holth Division
Wellman Engineering Co. 27
Arrow Tools, Inc. 19
Auto-Diesel Piston Ring Co. 145
Auto-Ponents, Inc. 143
Automatic Switch Co. ..... Cover 3

Barksdale Valves 31, 50
Bearings, Inc. 40
Beckett-Harcum Co. 14
Bellows Co. 35
Bendix-Westinghouse Industrial Products,
Bendix-Westinghouse Automotive Air Brake Co. 91
Benton Harbor Engineering Works, Inc. 44
Berry Hydraulics
Division Oliver Tyrone Corp. 137

Capital Engineering & Mfg. Corp. 54
Cardair
Div. Marmon-Herrington Co., Inc. 32
Cardwell Machine Co. 121
Chamberlain Industries Ltd. 139
Chicago Rawhide Mfg. Co. 33, 34
Clippard Instrument Laboratory, Inc. 125
Commercial Shearing & Stamping Co. 79
Crane Packing Co. 26
Cross Mfg. Co. 38

Darling Valve & Mfg. Co. 18
Denison Engineering Division
American Brake Shoe Co. 15
R. B. Denison Mfg. Co. 92
Dixie Bearings, Inc. 40
Dollinger Corp. 64, 65
Dynex, Inc. 41

Eastern Industries, Inc. 110
Eastman Mfg. Co. 13

Flodar Corp. 88
Fluid Controls, Inc. 133
Fox River Mfg. Co.
Division Hein-Werner Corp. 140
Friesland Plastics Co. 119
Fulflo Specialties Co., Inc. 16

Garlock Packing Co. 10, 57
Gast Mfg. Co. 135
Gates Rubber Co. 87
Goshen Rubber Co., Inc. 122
Greene, Tweed & Co. 142
Greenlee Tool Co. 136
Greer Hydraulics, Inc. 119
Gresen Mfg. Co. 132
Grover Piston Ring Co., Inc. 125

Hanna Engineering Works 1
Hannifin Co.
Div. Parker-Hannifin Corp. 99
Hansen Mfg. Co. ..... Cover 2
Hein-Werner Corp. 140
Helicoid Gage Division
American Chain & Cable Co. 98
Hoke, Inc. 139
E. F. Houghton & Co. 20, 21
Hunt Valve Co. 25
Hydraulic Accessories Co. 147
Hydraulic Press Mfg. Co.
Div. Koehring Co. 42
Hydraulic Unit Specialties Co. 134

Imperial Brass Mfg. Co. 83
International Packings Corp. 39

Jack & Heintz, Inc. 127
Jamesbury Corp. 56
Jarett Compressor & Equipment, Inc. 130

Kobby Co. 145
Koolavite Hydraulics Ltd. 59
Kopner Products Co 141
Kunkle Valve Co. 139

Le Roi Division
Westinghouse Air Brake Co. 58
Leiman Bros., Inc. 125
Lenz Co. 130, 143
Linear, Inc. 30

M-B Products Division
Tool Sales Co. 121
M. C. Mfg. Co. 112
Manatrol Corp. 135
Manning, Maxwell & Moore, Inc. 119
Marsh Instrument Co.
Division Colorado Oil & Gas Corp. 144
Marvel Engineering Co. 4, 5
Master Pneumatic, Inc. 46
Mead Specialties Co., Inc. 61
Mechanical Air Controls, Inc. 60
Metrolog Corp. 117
Miller Fluid Power Division
Flick-Reedy Corp. 81
Milwaukee Cylinder Co. 145
Minnesota Rubber Co. 2
Modernair Corp. 138
Monsanto Chemical Co.
Organic Chemicals Div. 28, 29
Moog Servocontrols, Inc. 53

National Seal Division
Federal-Mogul-Bower Bearings, Inc. 105
C. A. Norgren Co. 23

Oilgear Co. 11
Ortman-Miller Machine Co. 133

Palley Supply Co. 136
Parker Fittings & Hose Division
Parker-Hannifin Corp. 99
Parker Seal Co.
Div. Parker-Hannifin Corp. 107
Parker-Hannifin Corp. 99, 107
Pathon Mfg. Co. 36
Paul-Munroe Hydraulics 118
Periflex, Inc. 43
William S. Pine 146
Precision Rubber Products Corp. 126
Protective Closures Co., Inc. 17

Quincy Compressor Co. 121

Racine Hydraulics & Machinery, Inc. 55
Raybestos-Manhattan, Inc.
Packing Division 128, 129
Republic Steel Corp.
Steel & Tubes Division 123
Rouland Electric Co. 22
Robbins Aviation, Inc. 116
Rochester Mfg. Co., Inc. 114, 115
Ross Operating Valve Co. 9, 127

S-P Mfg. Corp. 141
Thomas Savery Pumps Ltd. 143
Sheffer Corp. 127
Shell Oil Co. 111
Snap-Tite, Inc. 63
Sundstrand Hydraulics Div.
Sundstrand Corp. 51
Super Oil Seals & Gaskets Ltd. 134
Superior Tube Co. 130

Tomkins-Johnson Co. 47
Tuthill Pump Co. 100

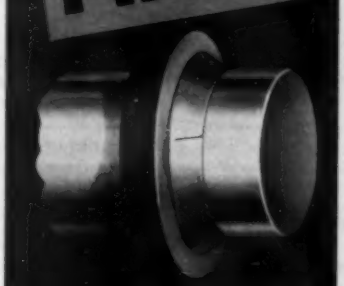
Universal Hydraulics
Div. Holan Corp. 120

Vickers, Inc., Div. Sperry Rand Corp.
Machinery Hydraulics Division 66
Vickers-Armstrongs (Engineers) Ltd. 37
Henry Vogt Machine Co. 97

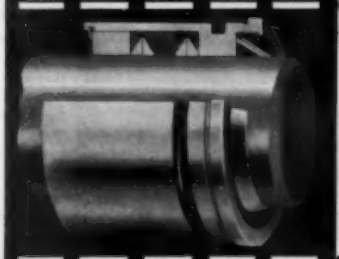
Wagner Electric Corp. 132
Warco Industries Inc. 132
Waterman Hydraulics Corp. 6
Webster Electric Co. 131
Wilkerson Corp. 94

Yates-American Machine Co. 12

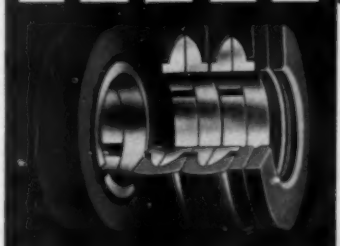
TOP QUALITY YOUR *Best* PROTECTION!



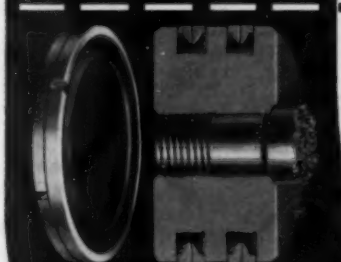
Seal-Guard
METALLIC ROD WIPERS
"Wipe off" dirt accumulation with rubber mounted, flexible bronze knife edges. Perform better, for longer.



MONOPAK CARTRIDGE
Compact, all-in-one package of packing, bearings, and rod wipers. Air or hydraulic cylinders. No machining or adjustments.



MONOPAK ROD PACKING
A highly efficient bearing and seal package for air or hydraulic use. Available in all desired sizes.



MONOPAK PISTON PACKING
A long lived, trouble-free, automotive type ring and packing for one or two piece pistons.

YOUR ASSURANCE OF BETTER PNEUMATIC OR HYDRAULIC SEALING.

Complete details and prices on request.

HYDRAULIC ACCESSORIES COMPANY

24301 Hoover Road
Warren, Michigan

Circle **64** on Time-Saver Card

PRODUCTS ADVERTISED IN THIS ISSUE

See advertisers' index on page 146-147 for location of ads

TIME SAVER CARD NUMBER

ACCUMULATORS
- Cardwell Machine Co. 28
- Greer Hydraulics, Inc. 54

AFTERCOOLERS
- R. P. Adams Co., Inc. 2

AIR COMPRESSORS
- Le Roi Division 77
- Palley Supply Co. 101
- Quincy Compressor Co. 110

AIR MOTORS
- Bellows Co. 22
- Gast Mfg. Co. 49

BOOSTERS
- S-P Mfg. Corp. 121

BRAKING SYSTEMS, AIR OR OIL POWERED
- Wagner Electric Corp. 135

CLAMPS, AIR-OPERATED
- Airmatic Valve, Inc. 4

CONTROL PANELS
- Cardwell Machine Co. 28

CYLINDERS
- Anker-Holth Div. 11
- Bendix-Westinghouse 23
- Benton Harbor Engineering Works, Inc. 24
- Cross Mfg. Co. 34
- Dynex, Inc. 39
- Hanna Engineering Works 57
- Hannifin Co. 58
- Mead Specialties Co., Inc. 88
- Miller Fluid Power 91
- Milwaukee Cylinder Co. 92
- Modernair Corp. 94
- Ortman-Miller Machine Co. 100
- Palley Supply Co. 101
- Pathon Mfg. Co. 104
- S-P Mfg. Corp. 121
- Tomkins-Johnson Co. 129
- Universal Hydraulics 131

DEHYDRATION EQUIPMENT
- Robbins Aviation, Inc. 116

ELECTRIC CONTROLS
- Clippard Instrument Laboratory, Inc. 31
- R. B. Denison Mfg. Co. 37
- Warco Industries, Inc. 136

ELECTRIC MOTORS
- Jack & Heints, Inc. 70
- Reuland Electric Co. 115

FILTERS, HYDRAULIC
- Capital Engineering & Mfg. Corp. 26
- Dollinger Corp. 38
- Marvel Engineering Co. ..... —

FILTERS, REGULATORS, LUBRICATORS, AIR & ACCESSORIES
- Arrow Tools, Inc. 12
- Hannifin Co. 58
- Jarett Compressor & Equipment, Inc. 72
- M-B Products 82
- Master Pneumatic, Inc. 87
- C. A. Norgren Co. 98
- Wilkerson Corp. 139

FLUID MOTORS
- Chamberlain Industries, Ltd. 29
- Denison Engineering Div. 36
- Dynex, Inc. 39
- Hein-Werner Corp. 44
- Keelavite Hydraulics, Ltd. 74

GAS COMPRESSORS
- Cardair 27

HEAT EXCHANGERS
- Yates-American Machine Co. 140

HOSE FITTINGS & ASSEMBLIES
- Alemite Division 6
- Anchor Coupling Co., Inc. 9, 10
- Eastman Mfg. Co. 41
- Gates Rubber Co. 50
- Lenz Co. 80
- Parker Fittings & Hose Div. 102

HYDRAULIC FLUIDS
- E. F. Houghton & Co. 62
- Monsanto Chemical Co. 95
- Shell Oil Co. 124

HYDROSTATIC TRANSMISSIONS
- Sundstrand Hydraulics 126

JOINTS, ROTARY SWIVEL
- Eastman Mfg. Co. 41

MAGNETIC PLUGS
- The Kebby Co. 73

MANIFOLDS
- Almo Manifold & Tool Co. 8

PACKINGS & SEALS
- Bearings, Inc. 20
- Chicago Rawhide Mfg. Co. 30
- Crane Packing Co. 33
- Darling Valve & Mfg. Co. 35
- Garlock Packing Co. 47, 48
- Goshen Rubber Co., Inc. 51
- Greene, Tweed & Co. 52
- E. F. Houghton & Co. 62
- International Packings Corp. 69
- Linear, Inc. 81
- Minnesota Rubber Co. 93
- National Seal 97
- Parker Seal Co. 103
- Periflex, Inc. 106
- Precision Rubber Products Corp. 108
- Raybestos-Manhattan, Inc. 112, 113
- Super Oil Seals & Gaskets Ltd. 127

PISTON RINGS
- Auto-Diesel Piston Ring Co. 13
- Grover Piston Ring Co., Inc. 56

POWER UNITS
- Cardwell Machine Co. 28
- Palley Supply Co. 101
- Paul-Munroe Hydraulics 105
- Vickers, Inc. 132

PRESSURE GAUGES
- Helicoid Gage Division 60
- Kunkle Valve Co. 76
- Manning, Maxwell & Moore, Inc. 85
- Marsh Instrument Co. 86
- Rochester Mfg. Co., Inc. 117

PRESSURE SWITCHES
- Barksdale Valves 19

PUMPS
- Adel Precision Products 3
- Berry Hydraulics 25
- Commercial Shearing & Stamping Co. 32
- Denison Engineering Div. 36
- Dynex, Inc. 39
- Eastern Industries, Inc. 40
- Hein-Werner Corp. 44
- Keelavite Hydraulics Ltd. 74
- Palley Supply Co. 101
- Thomas Savery Pumps Ltd. 122
- Tuthill Pump Co. 130
- Vickers-Armstrongs (Engineers) Ltd. 133

PUMPS, AIR
- Leiman Bros., Inc. 78

PUMPS, HAND
- William S. Pine 107
- Sheffer Corp. 123

PUMPS, VACUUM
- Leiman Bros., Inc. 78

QUICK CONNECT COUPLINGS
- Hansen Mfg. Co. 59
- Snap-Tite, Inc. 125

ROD & CYLINDER PACKING CARTRIDGES
- Hydraulic Accessories Co. 64

SEALING TAPE
- Friesland Plastics Co. 45

SEPARATORS
- R. P. Adams Co., Inc. 2

SERVO ANALYZERS
- Metrolog Corp. 90

SERVOVALVES
- Moog Servocontrols, Inc. 96

THERMOMETERS, BIMETAL
- Rochester Mfg. Co., Inc. 118

THREAD PROTECTOR
- Protective Closures, Inc. 109

TUBE FITTINGS
- Anchor Coupling Co., Inc. 10
- Flodar Corp. 42
- Imperial Brass Mfg. Co. 68
- Lenz Co. 79
- Parker Fittings & Hose Div. 102
- Henry Vogt Machine Co. 134

TUBING
- Republic Steel Corp. 114
- Superior Tube 128

VALVES, AIR
- Air-Mite Devices, Inc. 5
- Allied Control Valve Div. 7
- Barksdale Valves 16
- Beckett-Harcum Co. 21
- Hunt Valve Co. 63
- Jamesbury Corp. 71
- Manatrol Corp. 84
- Mechanical Air Controls, Inc. 89
- Ross Operating Valve Co. 119, 120

VALVES, AIRCRAFT
- M. C. Mfg. Co. 83

VALVES, HYDRAULIC
- Adel Precision Products Div. 3
- Automatic Switch Co. 15
- Auto-Ponents, Inc. 14
- Barksdale Valves 17, 18
- Beckett-Harcum Co. 21
- Dynex, Inc. 39
- Fluid Controls, Inc. 43
- Fulflo Specialties Co., Inc. 46
- Greenlee Tool Co. 53
- Gresen Mfg. Co. 55
- Hein-Werner Corp. 44
- Hoke, Inc. 61
- Hydraulic Press Mfg. Co. 65
- Hydraulic Unit Specialties Co. 66
- Jamesbury Corp. 71
- Kepner Products Co. 75
- Manatrol Corp. 84
- Racine Hydraulics & Machinery, Inc. 111
- Universal Hydraulics 131
- Henry Vogt Machine Co. 134
- Waterman Hydraulics Corp. 137
- Webster Electric Co. 138

VALVES, WATER
- Automatic Switch Co. 15
- Manatrol Corp. 84

WIPER RINGS
- Ace Products Co. 1
- Hydraulic Accessories Co. 64

TIME SAVER CARD---------- HYDRAULICS & PNEUMATICS

Facts At Your Fingertips

If you want details about products described or advertised in this issue, circle the number on the card that corresponds with the number under each advertisement or product description.

HYDRAULICS & PNEUMATICS

Was this copy correctly addressed?

If not, use this card to give us your complete mailing address plus the old (incorrect) one ----------

H&P is now addressed like this:	It should be changed to this:

Products manufactured (or other business carried on) at this address _____

My job title _____

Signature _____

JUNE 1960

Circle number to receive free information about any product described or advertised in this issue.

ADVERTISERS

1	21	41	61	81	101	121	141	161	181	201	221
2	22	42	62	82	102	122	142	162	182	202	222
3	23	43	63	83	103	123	143	163	183	203	223
4	24	44	64	84	104	124	144	164	184	204	224
5	25	45	65	85	105	125	145	165	185	205	225
6	26	46	66	86	106	126	146	166	186	206	226
7	27	47	67	87	107	127	147	167	187	207	227
8	28	48	68	88	108	128	148	168	188	208	228
9	29	49	69	89	109	129	149	169	189	209	229
10	30	50	70	90	110	130	150	170	190	210	230
11	31	51	71	91	111	131	151	171	191	211	231
12	32	52	72	92	112	132	152	172	192	212	232
13	33	53	73	93	113	133	153	173	193	213	233
14	34	54	74	94	114	134	154	174	194	214	234
15	35	55	75	95	115	135	155	175	195	215	235
16	36	56	76	96	116	136	156	176	196	216	236
17	37	57	77	97	117	137	157	177	197	217	237
18	38	58	78	98	118	138	158	178	198	218	238
19	39	59	79	99	119	139	159	179	199	219	239
20	40	60	80	100	120	140	160	180	200	220	240

Card Invalid Without Company Name — Type or Print

NAME _____

COMPANY: _____

POSITION: _____

PRODUCT MFG.: _____

STREET _____

CITY _____ ZONE ____ STATE _____

DO NOT USE AFTER SEPT. 15, 1960

NEW PRODUCTS

300	305	310	315	320	325	330	335
301	306	311	316	321	326	331	336
302	307	312	317	322	327	332	337
303	308	313	318	323	328	333	338
304	309	314	319	324	329	334	339

FREE LITERATURE

400	405	410	415	420	425	430	435
401	406	411	416	421	426	431	436
402	407	412	417	422	427	432	437
403	408	413	418	423	428	433	438
404	409	414	419	424	429	434	439

AVIATION DATA

500	505	510	515	520	525	530	535
501	506	511	516	521	526	531	536
502	507	512	517	522	527	532	537
503	508	513	518	523	528	533	538
504	509	514	519	524	529	534	539

JUNE 1960

Circle number to receive free information about any product described or advertised in this issue.

ADVERTISERS

1	21	41	61	81	101	121	141	161	181	201	221
2	22	42	62	82	102	122	142	162	182	202	222
3	23	43	63	83	103	123	143	163	183	203	223
4	24	44	64	84	104	124	144	164	184	204	224
5	25	45	65	85	105	125	145	165	185	205	225
6	26	46	66	86	106	126	146	166	186	206	226
7	27	47	67	87	107	127	147	167	187	207	227
8	28	48	68	88	108	128	148	168	188	208	228
9	29	49	69	89	109	129	149	169	189	209	229
10	30	50	70	90	110	130	150	170	190	210	230
11	31	51	71	91	111	131	151	171	191	211	231
12	32	52	72	92	112	132	152	172	192	212	232
13	33	53	73	93	113	133	153	173	193	213	233
14	34	54	74	94	114	134	154	174	194	214	234
15	35	55	75	95	115	135	155	175	195	215	235
16	36	56	76	96	116	136	156	176	196	216	236
17	37	57	77	97	117	137	157	177	197	217	237
18	38	58	78	98	118	138	158	178	198	218	238
19	39	59	79	99	119	139	159	179	199	219	239
20	40	60	80	100	120	140	160	180	200	220	240

Card Invalid Without Company Name — Type or Print

NAME _____

COMPANY: _____

POSITION: _____

PRODUCT MFG.: _____

STREET _____

CITY _____ ZONE ____ STATE _____

DO NOT USE AFTER SEPT. 15, 1960

NEW PRODUCTS

300	305	310	315	320	325	330	335
301	306	311	316	321	326	331	336
302	307	312	317	322	327	332	337
303	308	313	318	323	328	333	338
304	309	314	319	324	329	334	339

FREE LITERATURE

400	405	410	415	420	425	430	435
401	406	411	416	421	426	431	436
402	407	412	417	422	427	432	437
403	408	413	418	423	428	433	438
404	409	414	419	424	429	434	439

AVIATION DATA

500	505	510	515	520	525	530	535
501	506	511	516	521	526	531	536
502	507	512	517	522	527	532	537
503	508	513	518	523	528	533	538
504	509	514	519	524	529	534	539

Facts at your fingertips

FIRST CLASS
PERMIT No. 8066
CLEVELAND, OHIO

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY: *Reader Service Department*

HYDRAULICS & PNEUMATICS
812 Huron Road
Cleveland 15, Ohio

FIRST CLASS
PERMIT No. 8066
CLEVELAND, OHIO

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY: *Reader Service Department*

HYDRAULICS & PNEUMATICS
812 Huron Road
Cleveland 15, Ohio

FIRST CLASS
PERMIT No. 8066
CLEVELAND, OHIO

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY: *Reader Service Department*

HYDRAULICS & PNEUMATICS
812 Huron Road
Cleveland 15, Ohio

FACTS at your fingertips

The most modern Reader Service Department in the publishing industry, staffed and trained to help readers. Automatic equipment processes your requests and shoots them on for fulfillment within hours after receipt. The materials you want get to you — fast.

These cards are your tickets to this prompt service. Use them to secure details about any item in this issue that has a key number. For instance:

ADVERTISEMENTS—a showcase of the latest in components, equipment and techniques.

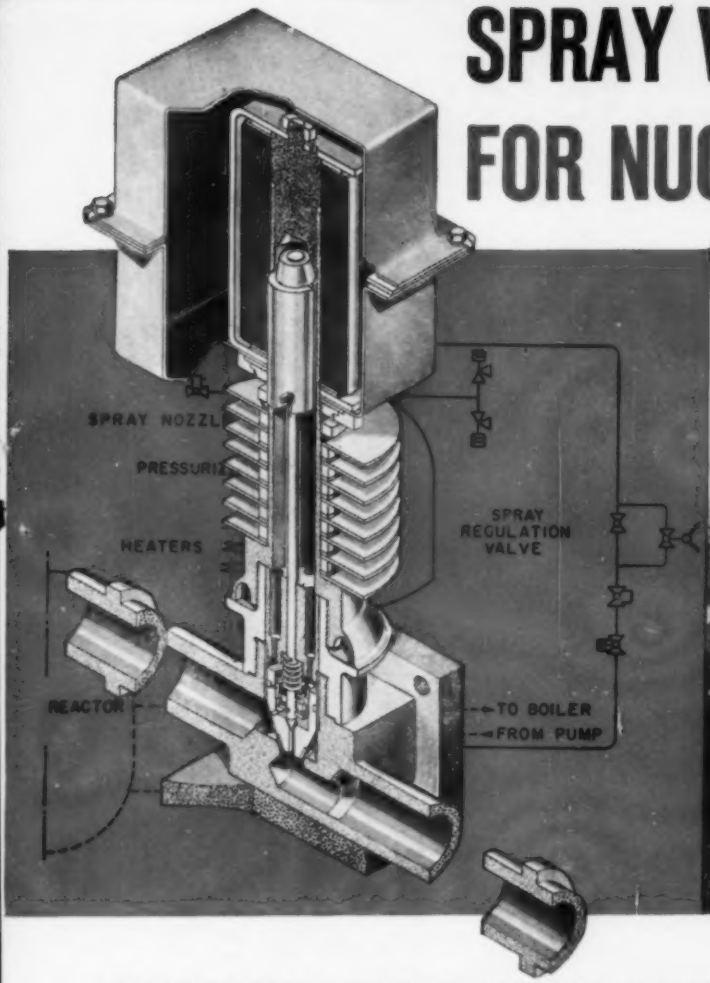
NEW PRODUCTS—brief descriptions of significant new products and materials.

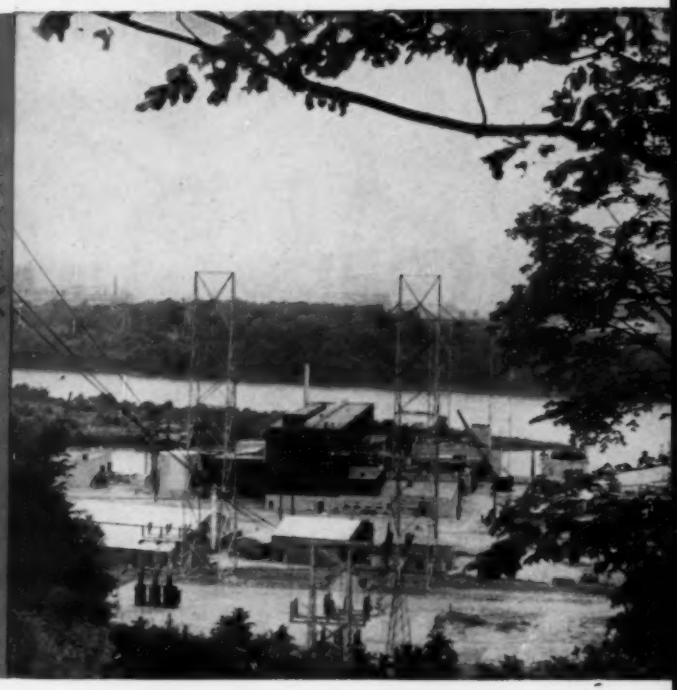
PRODUCT APPLICATIONS—brief reports on successful applications of recently developed products and materials.

NEW LITERATURE—offerings of new catalogs, data books, price lists, and other valuable reference material.

TIME SAVER CARD ---------- HYDRAULICS & PNEUMATICS

SPRAY VALVE FOR NUCLEAR REACTORS...





ASCO SOLENOID VALVE CONTROLS PRESSURE SURGES

ASCO – the only solenoid valve manufacturer in the industry with complete nuclear energy test facilities including a *hot test* loop – now offers a family of solenoid valves designed specifically for atomic energy applications.

The Spray-Valve shown in the cutaway above was developed especially to control pressure surges in the water cooled pressurized reactor. All stainless steel with stellite seats and discs, this unit has demonstrated reliability and maintenance-free operation under tests which duplicated the most strenuous operating conditions.

This packless type (hermetically sealed) solenoid valve is capable of large volume flow at low pressure differentials, handles pressures of 2500 p.s.i., at 675°F. Normally closed (closed when de-energized), it is supplied in 1", 1½" and 2" sizes.

ASCO Spray Valves are in use at Shippingport Atomic Power Station, and aboard nuclear submarines powered with water cooled reactors. Reliable and maintenance-free, ASCO 2, 3 and 4-way valves are specified for primary and secondary systems of nuclear reactors, as well as for instrumentation control.

For further information, request "ASCO Valves for Nuclear Reactors" and Catalog No. 202.

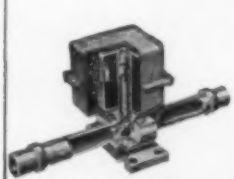
ASCO®

Automatic Switch Co.

50-8 Hanover Road, Florham Park
New Jersey.
FRontier 7-4600

Typical ASCO Solenoid Valves for submarines, military and commercial surface ships, and industrial power plants:

Primary System

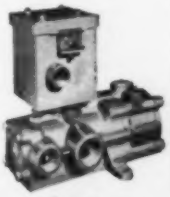


Isolating (Stop) Valve

Pressure Operated 4-way Valve

Secondary System

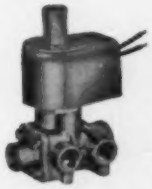
Manual Reset 2-way Valves



4-way Valves

Instrumentation Control

Manual Reset Valves



4-way Valves

Your time
is well spent
reading

APPLIED HYDRAULICS & PNEUMATICS

No man has time to read all the magazines that cross his desk. If he did he'd never get his job done. You probably know this from firsthand experience.

Distilled Writing, our own form of editorial quality control, makes articles shorter, easier to read . . . provides more articles per issue. More subjects are covered to interest you and hold your attention.

Articles in APPLIED HYDRAULICS & PNEUMATICS are edited specifically to help you do your work better, and keep you up with the changing times. There's no wading through a mass of publications to get the information you want and need.

The editorial staff of APPLIED HYDRAULICS & PNEUMATICS is knee-deep in its specialized field. They go where the story is . . . have the know-how to find it, evaluate it and tell it clearly to a specialized audience.

All of this specialized coverage fits a primary editorial objective: to make your time spent with APPLIED HYDRAULICS & PNEUMATICS well spent.

Franchise Circulation gets magazines to the men who buy

Distilled Writing gets magazines read

APPLIED HYDRAULICS & PNEUMATICS

THE INDUSTRIAL PUBLISHING CORPORATION

812 Huron Road • Cleveland 15, Ohio • SUperior 1-9620

Sales Offices: New York • Chicago • Los Angeles • London, England